THE

ELECTRICAL REVIEW.

VOL. LX. JUNE 14, 1907. No. 1,542.

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

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CHAOS AT JOHANNESBURG.

ENGINEERS, both in this country and abroad, have been watching with considerable interest the trend of matters in connection with Johannesburg's somewhat ambitious municipal electrical scheme, and with us, we believe, they will share mingled feelings of disappointment and surprise at the latest turn of events out there.

Our South African correspondent informs us that, as a result of the trouble experienced at the power station, the whole of the gas producer plant and generating sets were shut down from 6 p.m. on May 15th until further notice. With Johannesburg's extensive tramway and lighting undertakings, this suspension of supply is a very serious matter; the old steam plant, however, will be able to supply a limited number of consumers in the central area of the town, and possibly arrangements may be made with the Brakpan and other large generating stations for a supply to the suburbs as before, pending the introduction of the new steam plant which is on order.

It appears that a special meeting of the Town Council was held on May 17th, to consider the failure of the power station supply. The Committee then reported that the contractors had thrown up the running contract, abandoned the main contract and admitted that the machinery at the present time was not in a position to comply with the tests, and, further, that they were not prepared to do anything more to the machinery to make it capable of passing the tests. The Committee further reported that the sureties were not prepared to do anything more, either with the running contract or the machinery, other than enter into an agreement to endeavour to remedy the present state of affairs, conditionally on any expenditure going towards the reduction of the present liability of the sureties; without discussion, it was agreed not to entertain this offer. The Committee were, moreover, authorised to terminate the running contract, to call upon the sureties for the amount of £10,000, and to reject the whole of the generating plant in the terms of the main contract; also to demand from the sureties the sum named in the bond for the due performance of the contract, namely, £105,134.

That the contractors, a firm of the highest repute, who are understood to have produced and operated with every success the same type of plant at their own works, should have confessed their inability to remedy matters in this important instance, causes even more astonishment than disappointment to us. For, Johannesburg notwithstanding, the gas engine has come to stay; the Oechelhäuser type, in particular, having achieved great things on the Continent, under conditions which are fairly comparable.

From the recent report of Mr. J. F. I. Thomas, the manager of the electric light and power department, on the state of the plant (referred to in our issue of May 3rd), one can only conclude that defective design accounts largely for Johannesburg's tribulations, although why departures from

successful and recognised patterns should have been made in this, of all cases, involving as it did 7,500 KW. of plant, appears to be "wrop in mystry."

We venture to say that the decision of the consulting engineers, in the first instance, was generally regarded as a bold step, taking into account all the circumstances, but their boldness was almost justified in view of the unexpected quarter from which failure has arisen.

While regretting, exceedingly, the present state of affairs, we shall await with interest any further information tending to elucidate this mysterious failure, for mysterious it undoubtedly is, with our present knowledge and experience of the gas engine.

LONDON COUNTY COUNCIL ACCOUNTS.

THE majority in command of the new Council have lost no time in dealing with the question of accounts, which excited so much controversy during the recent election. The Finance Committee has issued a report, and states that there is no question as to the clerical correctness of the figures—which, indeed, was never disputed; the necessity for an independent audit was not raised upon that point, but upon the appropriation of items of expenditure which affected the cost of undertakings and obscured the actual results.

The capital expenditure, for example, on the construction of the tramways was a serious point raised, as it was alleged that great part of the cost of street widenings, consequent upon the undertakings, was not charged to them, but carried to improvements accounts, and by that means the apparent outlay upon the tramways was materially relieved.

The effect of this would be to decrease the amount of interest and sinking fund on the loans, and, consequently, reduce the charge against revenue, and by that means increase the gross profits.

It is an investigation into items of this kind—the rearrangement of the accounts rather than their clerical accuracy—that will render the services of independent auditors of so much value.

The results aimed at are formulated under the following heads :—

1. The past results and present financial position of the undertakings from a commercial point of view.
2. The basis upon which the valuation of the tramways was made in January last.
3. The sufficiency of existing renewal funds, the formation of further reserve funds, and the relation of these to the statutory sinking funds.
4. The allocation of expenditure under the several accounts, and particularly the apportionment of the cost of street improvements connected with tramways and of land appropriated for rehousing purposes.
5. The form of the published balance-sheets and other accounts.

There is nothing in this programme that should excite controversy—it commends itself to every man of business—and to describe this as the Moderates beginning "to get to work with their reactionary projects," to quote one of the daily papers, is sheer nonsense, and would rather lead one to suppose that the writer feared the result of investigation in view of the evidence it might furnish on the results of the municipal trading in electric tramways and other undertakings.

Mr. Cockerton, the Local Government Board Auditor, points out in his report upon the Council's accounts for the year ending March 31st, 1906, that a clause might be inserted in the Council's Tramways and Improvements Acts fixing the proportion of expenditure chargeable to different accounts—or, alternatively, that the Board of Trade should deal with the matter. If any such provision were made it should apply equally to similar undertakings operated by private companies and save them from much of the expenditure, which, in their case, sometimes assumes the character of blackmail.

Of course, the question of depreciation is involved in the proposal for an independent audit and this is strongly resented by those who under cover of the magic words "sinking fund" would brush it aside altogether.

In connection with this subject, the *Scotsman* published a few days ago an article on an interesting commercial inquiry by the U.S. Government. The question of depreciation on commercial undertakings where machinery is largely employed is under the consideration of the Government, and appears especially to interest the income-tax assessor, who, one would suppose, would prefer to keep the item out of the accounts altogether.

The United States Government in undertaking an investigation into the problem of depreciation will no doubt evoke some interesting data as to the best means of providing a replacement fund, and two methods are indicated: (1) An annual percentage charge upon the original cost of property, which fund can be used only for the replacement of the identical property when finally abandoned; (2) To apply the actuarial principle underlying insurance, thus permitting a fund accumulated by depreciation percentages to be expended in whole or in part during the year in which the fund is created. For example, an accumulation on engines 1, 2, 3, 4 may be expended to replace 5, and not kept in reserve until engine 1, 2 or 3 goes out of service.

The new brooms on the London County Council are getting to work without delay—stirring up plenty of dust, and when it clears away we may reasonably expect to have a more accurate view of the results of the Council's trading in public utilities.

Tenants for Life and Electrical Installations.

WE have often had occasion to refer in this column to the more serious defects in the Electric Lighting Acts which should form the subject of amendment. A recent case in the Chancery Division draws attention to a minor amendment which might easily be made in the interests of tenants for life. In *Re* Lord Leconfield's Settled Estates, which was heard by Mr. Justice Kekewich on May 28th, a summons was taken out under the Settled Land Acts by the tenant for life in possession of the certain settled estates in England, asking that the trustees might be directed to apply certain capital money in their hands in recouping the applicant the following sums expended by him out of his own moneys :—(1) £4,891 19s. 7d. for the construction of a new drainage system for the principal mansion house; (2) £3,299 9s. 10d. for the erection of an engine house for the engines which supplied the principal mansion house with electric light. The Settled Land Act, 1882, Sec. 25, provides that improvements authorised by the Act to be made with capital trust moneys are works for (Sub.-Sec. (1)) drainage, and (Sub.-Sec. (2)) saw mills, scutch mills and other mills, waterwheels, engine-houses, and kilns, which will increase the value of the settled land for agricultural purposes, or as woodland or otherwise. It was held that, assuming that the engine-house would increase the value of the settled land, taking settled land to include the principal mansion house, yet it would not increase its value "for agricultural purposes or as woodland or otherwise" within the meaning of Sub.-Sec. 12, and that its expense could not therefore be allowed out of capital moneys; but it was held also that the cost of the new drainage system could be allowed, for it was not a case of mere addition but a completely new system and a permanent improvement. This decision appears to be somewhat incomprehensible to the non-legal mind. The tenant for life was allowed to spend a considerable sum of money on the drains for the house, but was not permitted to put down an electric lighting plant. Yet, in the existing conditions of modern society, it is almost a *sine qua non* that a country gentleman's house shall be properly lit. A glance at the date of the Settled Land Act is sufficient to explain this anomaly. That measure was passed in the same year as the first Public Electric Lighting Act. At that time electricity was only in its infancy, and the fact that it has long since come to stay, and that as a source of light it is practically a common necessity, ought to afford sufficient justification for an amendment of the Settled Land Act. A short section might easily be drafted, which would give the Court power to decree that a tenant for life may spend part of his capital on electric lighting.

THE CREED RECEIVING TELEGRAPH PERFORATOR.

In the Wheatstone system, as generally employed, the Wheatstone tape or slip is prepared at the home station by means of a hand-worked perforator, and is then passed through a transmitter, the signals appearing at the distant end on the receiver slip as dots and dashes.

There has recently been introduced into the service of the British Post Office and several cable companies, a machine which perforates slip at the out-station. This machine (fig. 2) is the invention of Mr. F. G. Creed, of Glasgow, and is known as the Creed receiving perforator, or briefly, the Creed receiver. This perforating receiver reproduces, at a rate of about 150 words per minute as a maximum, an exact replica of the Wheatstone perforated tape

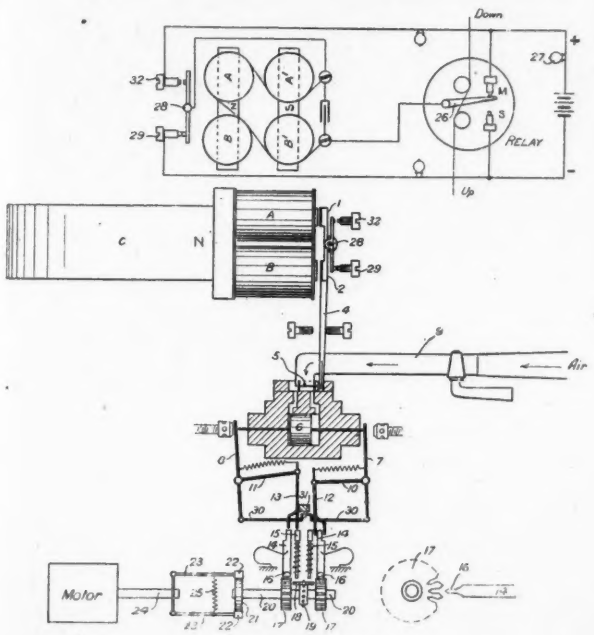


Fig. 1.—Diagram.

prepared at the sending end of a circuit. The mechanism for accomplishing this provides for :—

(*a*) Actuating punches under the control of, and in correspondence with, the line signals from the tape at the sending station ;

(*b*) Moving the receiving tape past the punches at a uniform speed approximating to that of the transmitter ;

(*c*) Momentarily arresting and holding the tape before and during the act of punching, and then releasing it promptly.

In order to accomplish *a* and *c*, compressed air is employed ; and for *b* a friction drive for the tape is used in conjunction with holding and releasing devices described later.

Fig. 1 shows in diagrammatic form the construction of the apparatus. A and B are electromagnets, shown in the upper diagram as A A′ and B B′ respectively. The two uppermost cores A and B are mounted on a soft iron yoke, the front ends of these cores being induced with north polarity by the horse-shoe permanent magnet C ; the lower cores A′ and B′ are similarly mounted and induced with south polarity by the other pole of the same magnet. The windings and connections are as shown in the diagram. A double yoked armature 1 and 2, arranged to turn on the pivot 28, is mounted as shown. A light tongue 4, is fitted to the armatures, its free end being attached to a double piston valve 5, which controls a double-acting piston 6. From each side of this piston a rod projects through the cylinder cover and thrusts in either direction the adjacent arms of the three-armed bell-crank levers 7 and 8. Compressed air is admitted to the valve through the tube 9, as indicated by the arrows, and thence to one side or the other of the piston. Upon the arms 10 and 11 are hard steel strikers 12 and 13, the free ends of which are bifurcated for the purpose of thrusting against the adjacent heads of the rods 14 and punches 15. These rods and punches are mounted and guided in a separate block, with the die plates and the feed wheel spindle. The correcting rods 14 have flattened points 16, terminating in a V-shape (shown separately), and when thrust forward are adapted to enter the slots in the correcting wheels 17. Retracting springs are provided, as shown, to restore the rods and punches to to their normal position against stops. The paper strip 18, which is previously centre-holed, is led up between the die plates, past the punches, and engages with the feed wheel 19, mounted upon the spindle 20, to which the correcting wheels 17 are also fixed. When the points 16 of any correcting rod 14, are thrust by the striker between the teeth of the wheel 17, the rod adjusts and holds the latter, as well as the feed wheel 19, and the tape, in such a position that the corresponding punch 15 will perforate the paper exactly opposite the feed holes. Mounted upon an extension of spindle 20 is a friction disk 21, driven by the friction blocks 22, fixed upon the pivotted arms 23, which are attached to the motor-driven spindle 24. This spindle rotates the feed wheel 19 at approximately the same rate as the feed wheel of the transmitter. For adjusting the driving tension the spring 25 is arranged to slide longitudinally on the rods 23.

The action of the machine is as follows :—A line-marking current in the relay coils deflects the tongue 26 to the contact M. A current flows from the battery through the lamp 27, contact M, the tongue 26, through the coils of the electromagnets to the contact-breaking tongue 28 (which is mounted on the spindle of armature 1 and 2), thence to the other pole of battery *via* contact 29. This causes the armature to be attracted by B and B′ and to move towards B B′, breaking the circuit at 29 and moving the valve sharply to the left, the

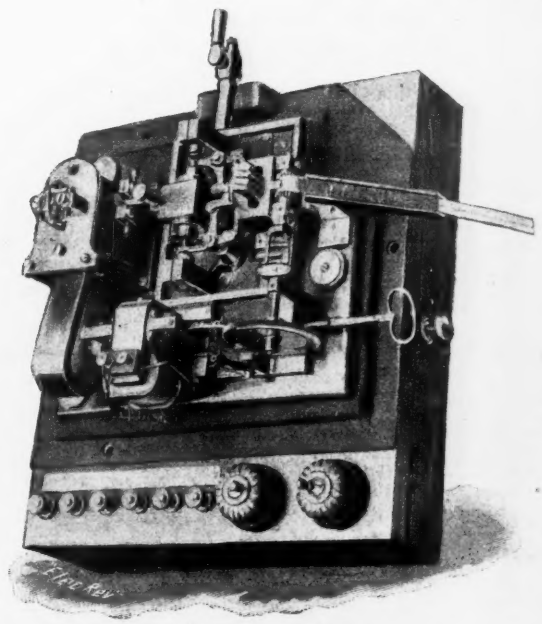


Fig. 2.—Receiver, with Cover Removed.

piston in consequence being driven to the right. The movement is transmitted by means of the bell-crank 7 and the link 30 to the bell-crank 8, which in turn causes the left-hand striker 13 to thrust the tooth of rod 14 between the teeth of the wheel 17, adjusting, if necessary, the position of the feed wheel, and forcing the corresponding punch 15 through the tape 18. The tappet piece 31 formed on the link 30 now comes in contact with the striker, forcing it from the rod and punch, and permitting them to spring back to their normal position. On the reversal of the line current the relay tongue returns to contact S, and a current passes through the coils in the opposite direction *via* screw 32, causing a reversal of the engine, when another operation similar to that described is performed by the right hand striker 12 upon the right hand correcting rod and punch.

D

As the complete operation of thrusting and releasing the punches occupies only the 300th part of a second, the time during which the feed-wheel is arrested is practically negligible, and the difference between dots and dashes in the tape depends entirely, therefore, upon the time-interval between successive spacing and marking contacts during which the tape is allowed to run on. Even between the marking and spacing currents for a dot, there is an appreciable interval during which the slip has travelled a little. The right hand punch, and the corresponding correcting wheel, are given a lead, so that, although the spacing punch is actuated later, the spacing perforation appears opposite the same centre-hole as the marking perforation.

The object of the Creed receiver is to save manual retransmission. For example, in the ordinary way, telegrams from a chief centre A, to a minor office C, have to be received by an intermediate office B, written up and retransmitted to C. By means of the Creed machine, the received perforated slip can be passed through the transmitter on the B C line. In the case of press work, B may be the transmitting centre for several offices, and the one received perforated slip can be utilised for automatically distributing the news to the various offices. At the centre B there is thus a saving of clerical labour.

The Creed receiver has been in successful operation for a period of over two years.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Publicity.

The contribution by Mr. Ben Frank, to your current issue, is both interesting and amusing, but surely he does not wish us to take it literally? It looks to me uncommonly like a skit on up-to-date business methods, which, of course, can very easily get overdone.

But in any case I submit that the main point of Mr. Frank's article has no more to do with "Publicity," as such, than it has with accountancy, and the concluding reference to "weird pamphlets and bulletins" convinces me that Mr. Frank is, first and foremost, a humorist.

Mr. Frank's original inquiry, as quoted by him, is not without blemish. When he specifies "sliding rails," should it not have been "slide rails," or did he want the rails to slide and not the motor?

Again, would not the firm supplying the motor with a pulley attached thereto, naturally require to know the size of the pulley? Yet this is not specified in Mr. Frank's inquiry.

Harold Elliot.

Manchester, *June 7th*, 1907.

[We congratulate our correspondent on having detected the humour in Mr. Ben Frank's article. As regards the "sliding rails," however, is he not hypercritical? Such current expressions as skating rink, eating house, laughing stock, &c., are not usually cavilled at.—EDS. E.R.]

Official Tests of Installations.

I suppose that at the great majority of tests made by Public Supply Authorities of lighting and, or, power installations, the instrument used to find the insulation value is the Evershed testing set, and I shall be glad to know what precisely is the legal standing of these instruments.

As most of us know, different supply authorities require different values of insulation resistance before they will connect, which, in itself, is much to be deplored, and the question arises as to the true value to be attached to the reading of the testing set as ordinarily used by the Supply Companies.

The matter was brought home to me a short time ago when I had occasion to get a small power plant ready for the local Supply Company's inspection and test.

Their rules required that every motor should have an insulation value of not less than one megohm, which is, I think, a reasonable requirement.

A test made by one of Evershed's "Megger" sets gave a value of about 1·2 megohms, but the Supply Co.'s instrument only read ·85.

As the "Megger" set had not long before been checked by the makers, and as it is seldom used except for the purpose of checking some four or five other sets, I was very certain that the true values were more likely to be given by this instrument, while the company's inspector naturally thought that his own was correct.

The result was that the company declined to connect, though, after a lengthy argument as to the enforcement of their rules when the installation complies with the regulations of the Board of Trade, *i.e.*, that the leakage should not amount to more than $\frac{1}{1000}$th part of the total current taken, they good-naturedly relented and connected up.

Although the matter ended satisfactorily, the real position regarding the ordinary supply authorities' rules seems somewhat obscure, and if you could give us some definite information on the matter, it would, no doubt, be helpful to many. Everyone, I think, from manufacturer to user, is interested in, and desirous of, obtaining the highest possible insulation on every circuit, but, at present, many of the tests made by supply authorities are practically useless so far as indicating what the real values of the insulation under working conditions are.

Finally: if the insulation resistance of an installation be such that the leakage is not more than the amount mentioned in the Board of Trade regulations, can the Public Supply Authorities legally refuse to connect?

W. H. B.

Electrician Wanted.

It seems a pity that your correspondent, "M. T. W.," after five years' college training and 16 years' practical experence, is not yet able to use his discretion in applying for suitable jobs; surely he must know that there would be no scope for a college man to charge accumulators on a gentleman's estate, and if he and his colleagues would only consider before applying for all and sundry jobs there may be going, employers would not have to wade through hundreds of quite unsuitable applications.

Then, again, to sling mud at a man just because the employment that he offers is not suitable to "M. T. W.," seems very bad taste; after all, 21s. per week, with residence on estate, would not be out of the way for a handy man with a little common sense.

Lyonel Andrew.

Stoke Newington, *June 4th*, 1907.

Rubber Cables.

In your issue of June 7th, page 916, Mr. Preece is reported as saying, in discussing Mr. Rogerson's paper at Leeds, that buyers of rubber insulated cables would be getting into the right direction if they specified "British Cable Makers' Standard."

Will he tell us what this is? It is information many of us have been looking for ever since the C.M.A. was formed. I presume by "British Cable Makers" he means the C.M.A. We are acquainted with the findings of the E.S.C., who specify particulars of conductor, thickness of insulation and minimum insulation resistance, but so far as my observation goes no specification beyond this has been issued by the C.M.A., and no universal specification of the constituents of the rubber is in use by its members. In fact, so far as is known, all cable makers, whether members of the C.M.A. or not, are agreed upon all the points published.

I would also ask Mr. Preece if the C.M.A. agrees with him that 30 per cent. of fine Para rubber is sufficient for 250 volts working pressure? If so, why is it necessary, and, by his own showing, advantageous to use 2,500 megohm grade in Glasgow, where the voltage is 250, and where the rules specify that the rubber core, on being burned, must not leave more than 40 per cent. of ash? But perhaps Mr.

Preece's firm have discovered some mineral substance which is combustible. Personally, I should consider 60 per cent. of fine Para rubber at least desirable for 500 volts. Mr. Rogerson rightly deplores the introduction of inferior grades by the C.M.A. The buyer cannot have the same confidence in buying from firms who make two distinct qualities, as apart from grades. Either inferior materials are introduced into the maker's works and stock, or he has really only one class and sells it cheap, or dear, according to circumstances.

The difficulty of forming at least a fair opinion regarding the rubber in the core is not insurmountable. If any *bona fide* Corporation engineer, or consultant cares to have one, I will send him a copy of a specification I have drawn up for really high class work, containing tests, of which some at least can be made by any engineer.

J. A. Rudd, M.I.E.E.

Glasgow, *June 10th*, 1907.

An Electric Car.

When I am a millionaire (which *entre nous* will not be just at present), I intend to have an electric motor car. Each of the wheels will be provided with a motor ; and the current will be furnished by a petrol engine coupled direct to a dynamo. But—and this is the important point—I shall place this engine and dynamo *on a separate "tender" drawn by the car;* so that the occupants of the latter will be free from all the vibration and other discomforts inseparable from a petrol motor. Note the advantages. Not only shall I be able to use a comparatively simple type of engine, but I shall be free from the worry and complication of change speed gearing. Moreover, the whole of the car will be available for the accommodation of passengers, and may be made in a form approximating to that of a railway saloon. The speed, perhaps, will not be greater than 12 or 15 miles ; but that will be no real loss to a tourist who appreciates scenery, and a distinct gain to other users of the King's highway. The swift petrol cars of the present day are rapidly becoming a public nuisance, and should give place to more suitable vehicles.

Separate Tender.

[The idea, we believe, is a familiar one, but may be worth reconsideration in view of recent developments.—EDS. E.R.]

The Electrical Trade.

Your contributor, "Agnostic," gives several reasons to account for the present state of the electrical trade. I consider all of these as secondary, and should like to substitute for them part of a single sentence included amongst his arguments in favour of a combine : "The crass conceit and blind self-worship of some heads of firms, acquired during days of unlimited prosperity."

This factor, to my mind, accounts more largely than anything else for the present state of the electrical trade. Most of our large manufacturing firms are governed by men who have no real business qualifications. In the early days when there was plenty of business and not much competition, these men had things all their own way and got business in spite of themselves. To-day they are trying hard to live up to their undeserved reputations by filling their works with orders taken at, or below, cost. This is not clever ; it is ruining their own business and everybody else's, and adversely affecting thousands of persons directly or indirectly dependent on them. It is no excuse to cry out that this action is necessitated by over-production, free trade, foolish contractors or wicked consulting engineers. If there is over-production (which I do not admit), then is not this the fault of those who, in their conceit and ignorance, so misjudged the market as to build huge works which they could never hope to fill with paying orders ? If free trade is the fault, how is it that these firms cannot even succeed with the goods that they import ? And if the other arguments put forward were also true, the plain answer is that the art of getting business is to do so in spite of the alleged adverse (and trivial) conditions.

But I maintain that there is plenty of business to be had, and paying business too. Consider the thousands of electrified factories, mills, collieries, quarries, &c., in the Kingdom ; the enormous fields for operation in the colonies ; the battlefields of neutral countries. The business is there, but businesslike methods are required to get it, and only men with the knowledge of what to do and how to do it will succeed. In order to prove my case, I would point to at least one large electrical manufacturing company, managed with success by smart men, which has always found plenty of paying business in all parts of the world ; also to two other companies whose directorates have recently undergone changes which are rapidly improving their positions. Yet they are working under exactly the same conditions as the companies whose directors are either suffering from a too easily obtained prosperity, or who are merely benevolent elderly gentlemen with a title and a taste for light occupation. (The directors of some electrical supply companies and railway companies may also be included in the latter category).

The comical, but rather sad, aspect of such companies is the continual effort towards re-organisation which goes on within. There is a dim instinct somewhere in the back of the directors' heads that all is not as it should be ; and so men are sacked, offices closed, new offices opened, and the staff change seats, or perhaps the whole lot move on one office like at the mad hatter's tea party. But how to re-organise effectually is quite beyond the powers of the heads, and so their firms are kept in a continual state of flux, and the staffs never feel secure from one day to another. It is—always organising, but never any organisation. If you will make inquiries, you will find that there are several firms in this parlous state, with no confidence between the staff and the heads, and what is worse—no respect. Every man is for himself, and the devil takes the hindmost ; and any man who dares to show merit combined with a desire to push himself forward is promptly sat on, deposed, or sacked.

These things are true, and until the directorates of some electrical manufacturing firms are pulled out root and branch, there will be no paying business done, and the trade will continue to stagnate.

But, I repeat, the business is there, and if it is sought in the right manner it will be found. For that reason I subscribe myself, not agnostic, but

Believer.

Amongst the many reasons for the present depressed state of the electrical industry, given in your issue of 7th inst., is the curious one put forward by "Agnostic," that it is all the fault of the consulting engineer who, by imposing his fads on manufacturers, has prevented standardisation.

If "Agnostic's" theory be correct, some large firms who certainly have not troubled themselves over-much about consulting engineers, should be making huge profits.

Who has not heard of cases where machinery of a quite unsuitable type has been put in, because it happened to be the makers' "standard" ; or because they could supply that particular type cheaper than their rivals ?

Standardisation, when within limits, is to be welcomed ; but if standardisation be undertaken too early, progress is hindered.

On the same page is a letter from "An Interested Spectator," giving another—and at the present time a much truer—picture.

Here we see a prospective buyer of electrical machinery receiving schemes, propositions and estimates from numberless firms, taking a year or two to consider the matter, and, finally, choosing the lowest tender which, as likely as not, was the one least suited to his needs.

Had a consulting engineer of repute been called in at the outset, he would have drawn up a clear statement of the requirements of the case, setting out the general lines to be followed, but leaving to the contractors the details of the methods by which these results were to be obtained. All the contractors would then have tendered on the same basis, and firms doing good work would not have been cut out by those willing to take the work at impossible prices in the hope of recouping themselves by "extras," or worse, by using inferior or unsuitable material.

In the name of fair play, is it not time to stop these attacks on consulting engineers ?

The true consulting engineer, by which I mean one of experience who is quite independent of all manufacturing or

contracting interests, is, I maintain, of great assistance to the industry.

If an asylum, or other large building has to be built, the builders and the brick makers do not go to the expense of designing the building; they confine themselves to tendering to the plans and specification prepared by the architect. Why, then, when a large engineering work has to be put up, should 50 contractors each discuss all the details with the purchaser, each prepare a scheme or schemes, and then at considerable expense and trouble proceed to explain to the non-technical purchaser exactly what their proposals mean? Surely it is better that one man should ascertain the requirements, draw up a scheme, and then see which firm can carry out the work on the most favourable terms.

The writer remembers a case where some large mills required an electric power installation. Being in touch with several large electrical firms, the manager asked them do put forward their proposals, giving them the usual vague idea as to his requirements. In order to avoid endless trouble, and to ensure that all should tender on the same basis, these selected firms agreed amongst themselves to ask a firm of consulting engineers to draw up a specification for the work, to which all were to tender, the consultants' fees being paid by the successful firm.

The difficulty is, of course, to define a consulting engineer, and to be sure that we are all thinking of the same person.

Unfortunately, any one can call himself a consulting engineer. The term as used at present may embrace Sir Alexander Kennedy or the managing director of a manufacturing or contracting firm, who, at the same time, tries to act as an independent adviser, or the employé of a corporation or a company who, not having sufficient work, or, more probably, not devoting the requisite attention to his proper work to occupy his time, is willing to advise on engineering matters.

In this respect, the Institution of Electrical Engineers, which ought to take the lead in such matters, is, I fear, to blame.

When the Institution is asked to suggest, say, an arbitrator in an electrical case, is it always careful to put forward the names of men who devote their whole time to consulting work, and who are absolutely independent of all trading or manufacturing interests?

I do not say that gentlemen not possessing these qualifications may not be perfectly competent to undertake the work in question, but I do say that, if consulting engineers are expected—as they are rightly, in my view—to be an absolutely impartial independent body of men, with a high standard of professional conduct, then they are entitled to the support and assistance of the whole industry, not excepting that of the electrical Press.

Fair Play.

The article upon the "Present State of the Electrical Trade" in your issue of June 7th, provides interesting reading.

Why is it, sir, that contractors when estimating do not base their tenders upon a reasonable profit being made from the work actually done by themselves, as well as upon the goods merely handled by them?

It is common knowledge that all the profit in some contracts is looked for from the manufacturers' discounts. Does this not, then, mean that the contractors have actually ruined a part of their business, and that a vital part? If so, sir—and your columns prove this to be the case—loyal support to the contractors must surely stop at the implicit placing of the manufacturers' business in their hands for similar treatment.

For remedy, "Agnostic" says "the industry demands less consulting engineer and more contractor," while "An Interested Spectator," in the letter which immediately follows, says satisfaction was not arrived at, though "22 contractors have tendered for a job of £2,500," which, presumably, was free from any consulting engineer element. Who shall decide upon such evidence?

Time was when all was mystery in connection with electrical apparatus. The contractor was then almost the sole channel for supply of goods from a binding screw to an "A" Gramme dynamo. But these days have long passed away, and quite common people nowadays think no more of reeling off a motor specification than "Ben Frank" did (see page 947), for they know what they require, and the terms in which to express the requirement without the intervention of either consulting engineer or contractor. It is, perhaps, worthy of note that "Ben Frank" does not add that the firm which nursed his inquiry so efficiently in the latest publicity method, pursued him relentlessly till they found out the interloper of a contractor he employed to fix that motor in position, so that they might claim a discount upon the transaction. But they evidently were guileless though verbose people.

The key to the situation does not rest entirely with the manufacturer, nor in the elimination of the consulting engineer, for it rests quite as much, if not more, with the contractor; and one essential to the turning of the key is that the last named shall realise his duty is to make his own labour a paying item.

If manufacturers have over-capitalised by opening new factories, which are not fully employed, they have no inducement to aggravate this by launching out into contracting work of any importance. No, sir, the contractor nowadays has to reckon with the expansion of what is known as "common knowledge." Doing so, he must honestly admit that his present method of estimating is out of date, unsatisfactory, and introduces a real menace to harmony in the industry.

Such, at any rate, is the opinion, sir, of

A Livelihood and a Little Over.

June 8th, 1907.

A COMPENSATED SINGLE-PHASE MOTOR WITHOUT EXCITING BRUSHES.

Dr. T. Lehmann has given the following particulars of tests carried out on yet another modification of the ordinary repulsion motor, in *L'Eclairage Electrique*. The machine was a 75-H.P. at 50 cycles (or 60 H.P. at 25 cycles) traction motor built by the Société Alsacienne de Constructions Mécaniques, and was arranged as shown diagrammatically in fig. 1.

The rotor has a bar winding with one turn per commutator section, and the stator winding, also of bars lying in half-closed slots, is divided into four branches A_1, A_2, B_1 and B_2. Of these A_1 and A_2 occupy eight slots per pole, whilst B_1 and B_2 occupy two slots per

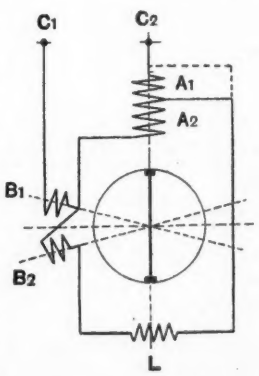


Fig. 1.

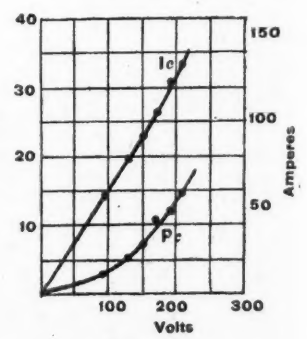


Fig. 2.

pole, and are arranged side by side at equal angles on either side of the normal to the brush axis. The compensating circuit is shown as including B_2 and A_2, but might equally well have been connected, as shown by the dotted line, so as to include $A_1 + A_2$ and B_2. The turns in B_1 and B_2 have to be chosen so as to give the necessary displacement of the compensating and exciting circuits relatively to the brush axis. In the present motor A_1 was made equal to A_2, and B_1 to B_2. L is an adjustable inductance.

The tests were carried out at the lower frequency of 25, so as to reduce the compensating action of the short-circuit currents under the brushes to a minimum. The influence of the ohmic losses is also greater at the lower frequency, so that, as regards both compensation and efficiency, the conditions are more severe at 25 cycles than at 50 cycles.

Fig. 2 shows the short-circuit characteristic obtained with the brushes fixed as in fig. 1, and with the compensating circuit

closed. The curve I c shows the variation of current with supply volts, and the curve P c the corresponding power variations.

Curves I o and P o of fig. 3 give the open circuit current and watts of the motor at various voltages, the brushes being raised. A comparison of figs. 2 and 3 shows that the apparent coefficient of dispersion of the motor is ·055, whilst the iron is unsaturated, and

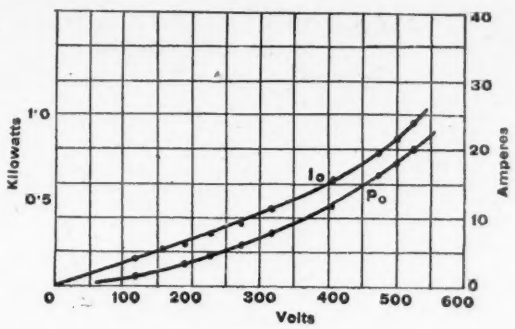


Fig. 3.

rises to about ·07 in the neighbourhood of 500 volts, when the iron saturation becomes noticeable.

The value of the inductance L is only about $\frac{1}{3}$th of that of the stator winding.

Fig. 4 shows the load characteristics with a constant supply current of 75 amperes. The figure includes curves of supply voltage E_1, power factor cos ϕ, compensating current I_2, power absorbed P_1, and voltage across the inductance E_2. The supply current I_1 was maintained constant at 75 amperes, whilst the speed was varied by

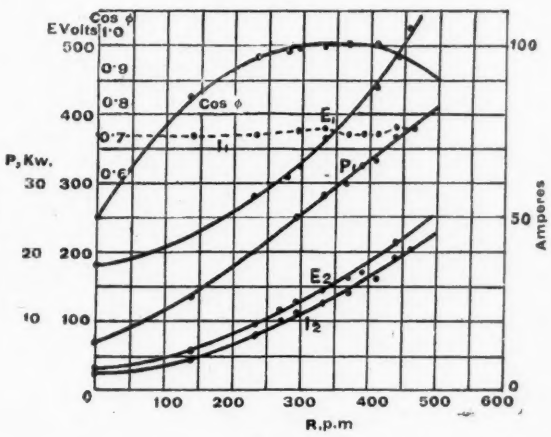


Fig. 4.

varying the supply volts. It will be seen that the automatic compensation was complete between 300 and 400 R.P.M., *i.e.*, without in any way adjusting the inductance L, the power factor remained unity between these speeds.

The motor, in fact, shows complete compensation at speeds well below synchronism, a result which is not attainable with the

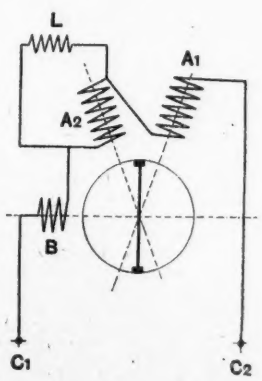


Fig. 5.

ordinary compensated repulsion motor having series exciting brushes as well as short-circuited brushes.

With a constant supply current of 50 amperes, the power factor is unity between 280 and 400 revs., whilst with 100 amperes the zone of complete compensation is more limited and does not continue above 330 R.P.M. This is owing to the fact that, with the higher current, voltages of 450-550 volts are required for 330 to 400 revs., and this involves saturating the iron and the consequent increase in leakage.

To overcome this difficulty, it would, however, only be necessary to reduce the inductance L, and so increase the compensating current I_2 at the higher speeds. If the characteristic curve of L were made to bend over similarly to the motor characteristic, this effect would result more or less automatically.

As regards commutation, the motor was irreproachable at both 25 and 50 cycles.

With a view to deciding how variations in the amount of the compensating current affected the power factor and the efficiency, a second similar motor was arranged as shown diagrammatically in fig. 5. This arrangement possesses some advantages over fig. 1, in that the whole stator winding is permanently connected to the supply circuit whether compensation is taking place or not. There were 10 slots per pole, of which 4 × 2 were occupied by A_1 and A_2, and two by B. The axes of A_1 and A_2 were separated by four slots, so that there were two slots on either side of the brush

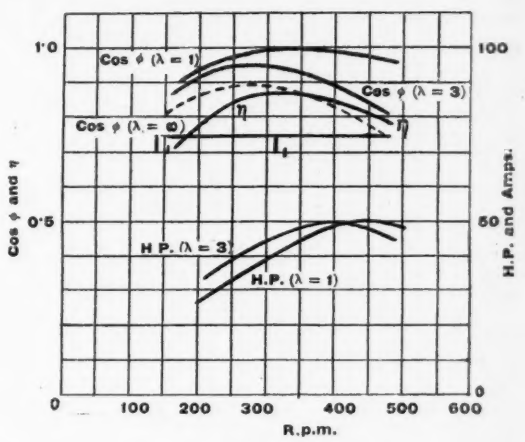


Fig. 6.

axis. The short-circuit and open-circuit characteristics of this motor were practically as in figs. 2 and 3. Fig. 6 shows the curves of power factor and efficiency obtained for various ratios $\lambda = \frac{\text{Total amperes}}{\text{Compensating amperes}}$, with a constant supply current $I_1 = 75$ amperes. As an ordinary motor without compensation ($\lambda = \infty$) the power factor never exceeded ·89. With $\lambda = 3$ it reached ·95, whilst complete compensation (cos $\phi = 1$) was obtained for $\lambda = 1$. The value of L used in the previous case corresponded practically with this last condition. The efficiency (η) curve is given for $\lambda = 1$, and does not include the loss in the inductance L, which amounted to about 1 per cent. at normal speed. It will be seen that the maximum efficiency occurs a little below synchronous speed (375 R.P.M.), and it falls to 75 per cent. at half synchronism. As λ falls (or the compensating current rises) the speed at which the maximum horse-power is developed rises.

The same motor tested at 95 amperes showed that λ had to be reduced to ·85 for complete compensation, and the power factor remained nearly unity even up to 700 volts (500 revs.). At this voltage the iron was highly saturated, and necessitated a magnetising current approaching the normal full-load current. It is clear, therefore, that large air gaps are quite permissible in these motors without detriment to their electrical qualities. The writer concludes with a mathematical investigation of some modifications of the above motor.

Electrolytic Reduction of Sulphides.—An American patent has been taken out by Mr. E. L. Anderson for the electrolytic reduction of the sulphides of zinc, copper, lead, &c., by means of cathodic hydrogen. The plant comprises a cathode of carbon, round which is a gauze basket containing the ore to be reduced, an inverted bell being placed over the whole to collect the sulphuretted hydrogen which is formed by combination of the liberated sulphur with the hydrogen. The anodes are also of carbon; and the electrolyte is so chosen that it does not attack the ore, but forms a soluble compound of the metal present. The inventor prefers to use hydrofluosilicic acid. The evolved sulphuretted hydrogen may be used for any convenient purpose, but the inventor specially suggests that it should be employed for the development of power in internal combustion engines.

PROCEEDINGS OF INSTITUTIONS.

The Experimental Determination of the Losses in Motors.

By Charles F. Smith, Wh. Sch., A.M.Inst.C.E., A.M.I.E.E.

(Abstract of paper read before The Institution of Electrical Engineers, *at Manchester, April 9th,* 1907.)

Part I.—Direct-Current Motors.

A number of methods for separating the losses in a motor or generator, all depending on the study of the retardation curves of an unloaded machine, have been described and widely adopted. The machine to be tested is run up to full speed, or to a speed slightly higher, and the armature is then disconnected from the source of power. The machine will be brought gradually to rest under the influence of the forces opposing its rotation, due to the frictional and iron losses which occur in the rotating machine. The work done during any interval of time in overcoming these losses as the machine retards will be equal to the kinetic energy lost by the machine in this time interval. The kinetic energy lost per second is then the power overcoming the losses. Since the kinetic energy will depend only on the speed (for a given machine), it is not difficult to determine the variation in the losses, as the machine slows down, by taking observations of the speed at successive equal intervals of time. By plotting a curve of speeds on a time base, the rate of change of speed, and consequently the rate of change of kinetic energy, may be deduced when once the kinetic energy at any single speed has been determined.

In absolute units, the kinetic energy of a rotating body is $\frac{1}{2}I(2\pi n)^2$, where I is the moment of inertia and n is the speed of the body in revs. per second. Translated into practical units this becomes

$$\text{Energy} = I\, n^2/5{,}800 \text{ ft.-lb.}, \qquad (1)$$

where I is in lb.-ft.^{2} and n in revs. per minute.

Writing K' for the constant quantity $1/5{,}800$,

$$\text{Energy} = K'\, n^2.$$

Suppose the speeds observed at two successive readings near together to be n_1 and n_2, and let the mean of these be

$$n = \tfrac{1}{2}(n_1 + n_2),$$

then the mean power producing the change of speed = energy lost ÷ time between observations

$$= K'(n_1^2 - n_2^2)/t = 2\, n K'(n_1 - n_2)/t \text{ ft.-lb. per min.}$$

where t is the time in minutes between the readings.

Since 1 ft.-lb. per min. = 0·0226 watt,

$$\text{No. of watts} = 0{\cdot}0452\, n K'(n_1 - n_2)/t = K n (n_1 - n_2)/t \qquad (2)$$

where $K = 0{\cdot}0452 K'$.

The experimental retardation curve is plotted to a large scale, with time measured horizontally and speeds vertically (see fig. 1). At any point on it corresponding to a speed of n revs. per minute, the value of $n_1 - n_2$ is obtained by scaling the difference in height of the curve at speeds n_1 and n_2 at equal horizontal distances on either side of n. The value of t, the time interval corresponding to the difference $n_1 - n_2$, must be taken so small that the curve is practically straight within these limits. Usually the time interval between two successive readings would be suitable.

Arnold has shown that, instead of the expression $n(n_1 - n_2)/t$, the subnormal to the curve at the point corresponding to speed n may be taken.

Thus, in fig. 1, the watts spent in retardation at point P = K × ½ A B.

I have found it best to measure off the length $t_1 - t_2$, as first described, rather than to measure the subnormal.

Determination of K.—The chief variations in the form of the experimental determination of losses by this method, as proposed by various experimenters, are to be found in the method adopted for the determination of K.

A summary of the chief methods available for finding the moment of inertia of an armature has been given by Dr. A. Hay.* The simplest is a comparison of the electrical power taken to maintain rotation at a certain speed with the rate of retardation when allowed to retard at the same speed from a higher speed.

The machine must be run at the normal speed for a sufficient length of time for the bearings to get to the stationary condition as regards temperature. The watts taken at this speed are then noted, and the speed is raised. The machine is immediately afterwards allowed to retard, readings of speed at equal time intervals during the retardation being taken. There will be a normal running condition of the bearings corresponding to each speed, so that one no-load reading should be taken for each retardation curve, if several determinations of the constant are to be made.

The speed is generally best determined by using a high-resistance voltmeter connected to the terminals of the machine, since speed and voltage at no-load will be proportional to one another, and the residual magnetism will produce sufficient voltage to give satisfactory readings in the case of the unexcited machine.

Where the time of retardation is short, Mr. U. A. Oschwald, B.A., has used the Hospitalier Ondograph as a recording voltmeter.

The constant K, connecting the slope of the curve with the watts absorbed, was calculated by the method described above. Fig. 2 shows three curves from the Ondograph records.

From these curves and the constant determined by previous experiment, the iron and friction loss curves shown in fig. 3 were plotted. The lowest curve represents the total friction and windage loss, and the ordinates between the upper curves and the friction curve represent the iron losses at the values of the excitation taken.

The curves show the rapidity and accuracy with which a separation of the losses may be made by the use of some form of recording voltmeter.

Since the losses in small motors are relatively high, and the inertia of the armature is relatively low, the method can only be made applicable to such machines by making the readings automatic as just described, so that retardations of very short duration may be observed, or by increasing the time of retardation by increasing the inertia of the rotating parts, for instance, by mounting a disk or heavy pulley on the shaft in place of the ordinary pulley or coupling. The addition of a moderate weight to the shaft will probably not increase the friction losses in the bearings, but will add to the loss in windage. A correction for this increased loss due to the added weight may easily be made by running the motor at the same speed, first with and then without the additional weight; the difference between the two driving powers will then represent increase in loss due to this cause.

A further advance in the direction of increasing the ratio of inertia to retarding forces leads to the suggestion that by sufficiently increasing the inertia of the rotating system, the retardation (or acceleration) curve might be employed for studying the losses in a motor when working under load. This would involve the use of a separately-mounted fly-wheel, to which the motor might be coupled.

Supposing the value of the constant K to be known with sufficient accuracy, observations of the speeds of the fly-wheel at successive equal intervals of time, when plotted on a curve, may be made to give a value for the power expended in its acceleration.

The method of determining the losses in a machine to be tested will then be carried out somewhat as follows:—

After a continuous run in which the machine has reached its normal working temperature, it is coupled to the fly-wheel. If of the shunt type, the motor field will be connected to a constant voltage, while the armature is connected to the supply mains through a finely adjustable rheostat, preferably of the liquid type, in series with an ammeter. The machine is then made to run up to full speed, while the armature current is kept constant at its full load value, by adjustment of the rheostat. During the acceleration, readings of the speed are taken at regular intervals given by a clock or metronome. If the total losses in the machine are required, the coupling between the motor and fly-wheel is now slipped out of gear, and readings of the fly-wheel speed are taken as it comes to rest.

From the plotted curve of acceleration, the power spent in producing the kinetic energy of the fly-wheel at full speed is obtained, and from the retardation curve of the fly-wheel alone, the power spent in overcoming its frictional losses. The sum of the two values of power thus obtained gives a measure of the total output of the motor at the speed considered, since this will be equal to the sum of the power spent in overcoming the friction of the fly-wheel and the power spent in accelerating it. By allowing the fly-wheel to retard from full speed with the motor on open circuit but excited, and still coupled to it, the ordinary no load "stray power" losses of the motor may be obtained, after subtracting the fly-wheel windage and friction losses obtained before.

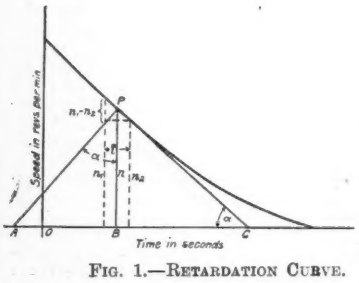


Fig. 1.—Retardation Curve.

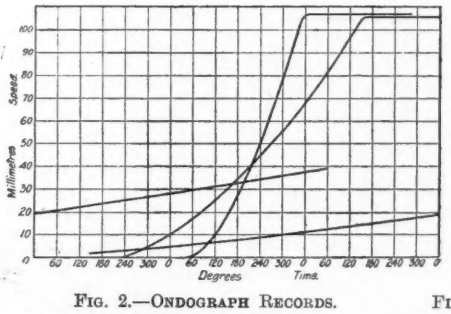


Fig. 2.—Ondograph Records.

Upper curve, 3·9 amperes excitation; next curve, 1·9 amperes; bottom curve, zero amperes.

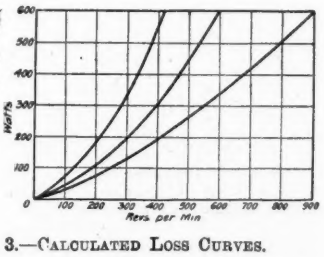


Fig. 3.—Calculated Loss Curves.

Top curve—excitation = 3·9 amperes; second curve, excitation = 1·9 amperes; bottom curve, friction only.

* Electrical Review, Vol. 47, pp. 287 and 327, 1900.

A retardation curve, corresponding to the acceleration curve obtained by making the motor drive the fly-wheel, may be obtained by causing the fly-wheel to drive the motor. For this purpose the motor is disconnected from the electrical supply after it has driven the fly-wheel up to full speed. It is then short-circuited on to the liquid rheostat, to which it thus supplies current, while the fly-wheel becomes the source of power in virtue of its kinetic energy.

By regulating the rheostat to maintain the constant full-load current, a similar curve to the acceleration curve is obtained from readings taken in the same manner.

The time of retardation under these conditions is less than the time of acceleration, because the frictional and other losses now diminish, instead of increasing, the duration of the run. The retardation curve is, consequently, steeper than the acceleration curve.

Perhaps the most interesting point in connection with the taking of a retardation curve, as well as an acceleration curve, is that we are thereby enabled either to dispense altogether with the evaluation of the constant K for the fly-wheel, or to determine it with much greater accuracy than by the more usual no-load method. This may be done as follows:—Let the acceleration and retardation curves be plotted in terms of induced voltage, instead of speed. As the excitation is assumed to be constant, the induced voltage is obtained by adding or subtracting the armature resistance drop (a quantity which may be assumed constant for the constant current) from the measured terminal voltage of the machine.

Let A be a point on the acceleration curve, and B a point on the retardation curve corresponding to the same induced voltage as A. Let v be the back volts at A and B.

Let dv/dt be the slope of the curve at A, and dv'/dt the slope at B.

The current and induced voltage being the same in the armature for both cases, the watts producing electrical acceleration will be the same. Let these be denoted by W. Since the speeds corresponding to A and B will be almost identical, we may assume the iron and friction losses to be equal for the two points. Let these losses be l—

$$\text{Then total accelerating watts at A} = W - l$$
$$\text{retarding watts at B} = W + l$$

and it may be shown that $l = W \dfrac{dv' - dv}{dv' + dv}$. ... ... (3)

This gives the iron and friction losses as a function of the load on the machine, without any necessity for a determination of the constant K.

From equation (3) we could obtain directly the mechanical efficiency of the whole apparatus, consisting of motor and fly-wheel. Thus—

$$\text{Mechanical efficiency} = \frac{W}{W + l} = \frac{1}{1 + \dfrac{dv' - dv}{dv' + dv}} \quad \ldots \quad (4)$$

Since this contains the losses in the fly-wheel as well as those in the motor, we must make a correction in the values for dv and dv' if we wish to arrive at the efficiency of the motor alone.

If du is the increase in the height of the retardation curve of the fly-wheel alone taken at the same speed, and for the same time-interval as dv and dv', then the fall in the retardation curve due to the motor losses alone will be $dv' - du$.

Similarly the change in the acceleration curve due to motor losses alone will be $dv + du$.

Hence putting $dv' - du = \delta v'$ and $dv + du = \delta v$,

the mechanical efficiency of the motor becomes—

$$\text{Efficiency} = \frac{1}{1 + \dfrac{\delta v' - \delta v}{\delta v' + \delta v}} \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

All the quantities in this expression are directly obtained from a pair of acceleration and retardation curves of the motor and fly-wheel and a retardation curve of the fly-wheel alone.

It is to be noted that this efficiency is calculated on the assumption of a constant C R drop in the armature. Any change in this will affect the value of W, and will alter the apparent value of the mechanical losses.

One of the chief merits of the retardation methods of testing is, that all readings are of the simplest character and may be made with a high degree of accuracy, the mean error being further reduced from the fact that the readings are plotted on curves before being used for calculation.

With a little practice, I found it possible to maintain the current so nearly constant that its maximum variation on either side of its correct value was not more than about ½ per cent., and its mean value must have differed by quite a small fraction of this from the normal.

One of the principal objects which I had in view in employing a fly-wheel to obtain load curves on a motor was to see if it was possible by this method to obtain the value of the stray-power losses of a *loaded* machine, so as to compare them with the stray power at no load, which is measured comparatively easily by several methods.

The following results were obtained on a machine, the particulars of which are as follows:—

Makers, Lahmeyer Electrical Co., 31 B.H.P., 4 poles, 110 volts, 1,100 R.P.M. Armature provided with two-circuit winding in 41 slots. Poles laminated. The brush rocker was intended for four sets of brushes, only two sets of which were employed. The motor was coupled by a crown clutch to a solid cast-steel fly-wheel, 22 in. in diameter, 4½ in. thick, and weighing about 480 lb., which was independently mounted on roller bearings.

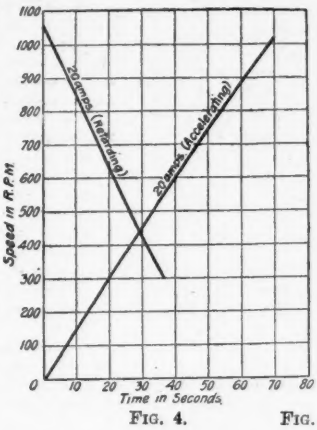


FIG. 4.

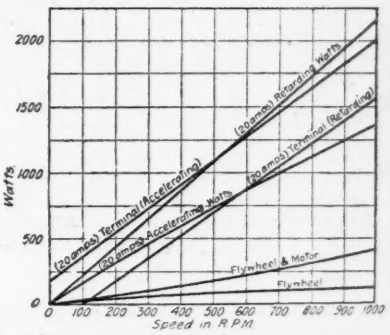


FIG. 5.—WATT CURVES CALCULATED FROM FIG. 4.

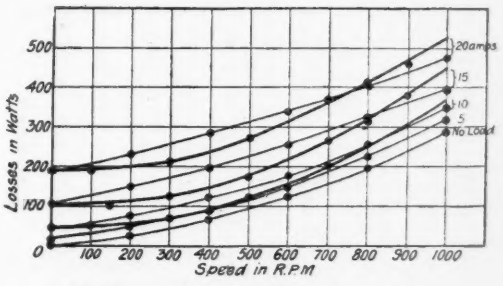
After the motor and fly-wheel had been allowed to run for several hours to ensure normal conditions, they were stopped. The motor was then made to run up to full speed with an absolutely constant armature current, while readings of speed and armature voltage were taken every four seconds. After running the set up a little beyond normal speed, the armature was disconnected from the supply and short-circuited across the water resistance. Similar readings were again taken during retardation, the current being kept at the same constant value as before.

In the particular series of results from which the curves figs. 4-7 have been plotted, acceleration and retardation curves were taken for currents of 20, 15 and 10 amperes; while retardation curves were also taken for 5 and 0 amperes for which it was not possible to get acceleration curves.

Fig. 4 shows a typical pair of acceleration and retardation curves for 20 amperes.

The complete series of curves were plotted out to a large scale, and the watt curves like those shown in fig. 5 were worked out by using the calculated value of the constant K, obtained direct from the curves themselves. By the earlier method of determination, the value of the constant could not be relied upon to within about 1 per cent. The later values agreed within 2 or 3 per thousand for any particular series of observations.

The difference between the last two curves represents the no-load stray losses of the motor.



Thick lines = accelerating. Thin lines = retarding.

FIG. 6.—LOSSES OBTAINED AS DIFFEBENCE BETWEEN CALCULATED AND TERMINAL WATTS.

In fig. 6 the total motor losses are plotted for currents of 5, 10, 15 and 20 amperes on a base of speed. These losses were obtained, in the case of the acceleration curves, by subtracting from the terminal watts the watts actually producing acceleration of the fly-wheel, together with the watts lost in friction of the fly-wheel. For the retardation curves, the terminal watts and fly-wheel friction watts were subtracted from the total retarding watts. In each case the thick lines in fig. 6 represent the losses obtained in this way from the "acceleration" curves, while the thinner lines are from the results of retardation. It will be seen that the values for the losses in the machine, when running at a certain speed with a particular armature current, appear to be different when the machine is acting as a motor from the losses when it acts as a generator. Further, the variation with speed of the losses in the two cases is not the same. This difference, which always appeared in my experiments, I am not able completely to account for. The maximum divergence between a mean curve and the thinner lines does not exceed 25 watts.

Finally, fig. 7 gives the increase in stray power obtained, as a function of speed for the four currents taken. It will thus appear that the stray power increased with both speed and load. The total increase of stray power losses at 20 amperes and 1,000 revolutions is 2½ per cent. of the total watts in the motor

FIG. 7.—INCREASE OF ACTUAL LOSSES ABOVE LOSSES ESTIMATED FROM NO-LOAD READINGS.

armature. The greater part is accounted for by increase in brush contact resistance. The actual contact resistance decreases with current, but increases rapidly with speed. About ⅘ of the losses shown in fig. 7 were due to brush resistance. This leaves an increase in stray power loss of about ½ per cent. of the output of the motor to be assigned to other causes.

My experiments have been confined to a single machine, so that a general conclusion cannot be drawn from the results.

For machines of small size, the heat run in the test house is most suitably and economically carried out with the machines coupled in pairs, as for a Hopkinson test. It is suggested that after the usual heat run has been taken, such machines should be coupled to the fly-wheel and an acceleration curve taken, at constant full-load current. The necessary connections are of the simplest character, and the time required for the observations would only be a couple of minutes.

The characteristics and frictional losses of the fly-wheel would be known, and it would, therefore, be easy to calculate the efficiency of the motor from the acceleration curve.

Take a fly-wheel about 5 ft. in diameter, with a rim 6 in. × 6 in., built up of steel; allowing a maximum speed of 300 ft. per second, this wheel would have a maximum safe speed of, say, 1,100 revolutions per minute. The approximate weight of the wheel would be 2,690 lb, and its moment of inertia, say, 14,720 lb.-ft.²

For a full speed of 1,000 and time of acceleration 1 minute,* the largest size of motor which could be tested would be 150 H.P.

In most cases it would probably be unnecessary to make any correction for the change of moment of inertia due to the mass of the motor armature.

If, while the motor is driving the fly-wheel, the armature circuit is suddenly opened, the terminal voltage will at once fall to the voltage which the machine will have when working as a dynamo on open circuit at the speed at which it is then running. If the armature circuit is opened while the machine is being driven by the fly-wheel and acting as a generator, the terminal voltage rises, by an amount equal to the armature drop, to its no-load value. It is thus easy to determine very exactly the armature drop due to any current, and also to find its amount for any brush position and speed.

It has been found that even with the brushes set in the neutral position, it is not possible to depend on obtaining exactly the same value of the armature reaction drop when accelerating and retarding. As a result of this effect, I decided in my experiments to measure the speeds by using a small auxiliary generator having constant excitation coupled to the shaft of the fly-wheel.

* The time of acceleration will actually be more than 1 minute under the conditions assumed, owing to the frictional resistances.

PART II.—ALTERNATING-CURRENT INDUCTION MOTORS.

F. Blanc has suggested a method for the determination of the no-load losses of an induction motor by measurement of the slip and of the rotor current and resistance.

Except for the uncertainty of the resistance of brush contacts on slip rings and starting rheostat, this method is found to give reliable and consistent results for the losses overcome by the rotor. It is, however, not correct to take these losses as being the true friction losses, and the method is only applicable to motors with wound rotors.

A method somewhat similar to the last in principle is that due to Dr. G. Benischke, which depends on the fact that for small values of the slip, the total torque of the rotor varies in direct proportion to the slip. The slip of the motor is measured at no-load and at one or two loads slightly above no-load. A curve is then plotted on a base of torque—or more conveniently watts—with slip as ordinates (see fig. 8). Joining the points thus obtained by a straight line, and continuing this line backwards to cut the horizontal axis at a point corresponding to zero slip, the distance of this point to the left of zero output will be the power exerted by the rotor in overcoming frictional and other resistances to its rotation.

The actual power measured in this case, as in the last, is really the friction + pulsation losses − the mechanically converted hysteresis loss.

This method is fairly easy to carry out if a convenient method of applying a small load to the motor is available. It is equally applicable to motors with wound and squirrel-cage rotors.

A very simple application of the retardation method of measurement may be employed to complete the determination of the friction losses attempted by the authors of these tests.

If the induction motor be run up to full speed in the usual way, and, when running light at full speed, if the rotor circuit be opened, the rotor will slow down and gradually come to rest. The retarding forces will be those due to friction and magnetic pulsation in the teeth, while the rotor hysteresis will tend to accelerate the rotor and prolong the time of coming to rest. During the early part of the retardation, these will be the only forces to be considered. As the slip becomes large, eddy currents will be formed in the rotor core and conductors which will produce a diminution of the effective retarding forces. If a retardation curve is plotted with time measured horizontally, and speed vertically, from observations made on the motor while retarding as described, a tangent drawn to the curve near the point of maximum speed will make an angle α with the horizontal axis such that its tangent, ds/dt, is proportional to the losses $w_f + w_p - w_h$.

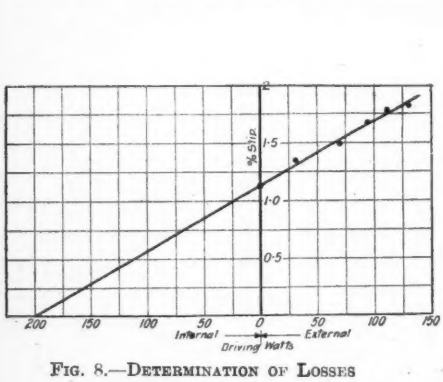


FIG. 8.—DETERMINATION OF LOSSES BY BENISCHKE'S METHOD.

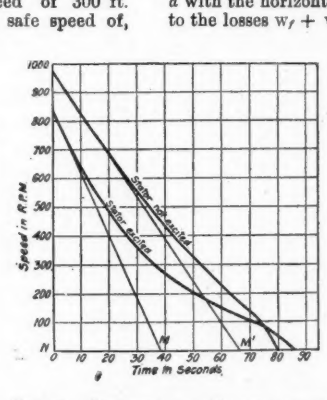


FIG. 9.—RETARDATION CURVES WITH STATOR EXCITED AND UNEXCITED.

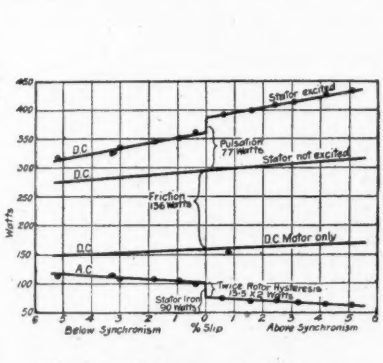


FIG. 10.—SEPARATION OF NO-LOAD IRON LOSSES.

Now suppose that another retardation curve is taken with the stator open-circuited. In this case retardation will be due to frictional losses only, and a tangent to the second curve ds'/dt at a point corresponding to the same speed as the first tangent will be proportional to the friction watts w_f.

As the heights of the points from which both tangents are drawn are taken to be the same, the subtangents will be inversely proportional to the retarding watts in the two cases, and we have the relation (see fig. 9).

$$w_f = NM/NM'. (w_f + w_p - w_h)$$

from which the true friction watts are determined from the value of $(w_f + w_p - w_h)$ obtained in either of the tests described above.

In taking the two retardation curves, since only the *ratio* of the initial slopes of the curves is required, it is immaterial how the readings are taken, so long as the two curves are strictly comparable. Also only a few reading are required near the maximum speed. With motors of fairly large size it would be sufficient to observe the times taken to retard by a certain amount after opening in one case the rotor, and in the other case the stator circuit.

The effect of eddy currents in causing the curves to approach one another and then cross, is well shown in fig. 9.

Retardation methods for measuring losses, which are so well adapted for measurements on direct-current and synchronous alternating machines, have only a limited application in the case of induction motors.

The simplest method of determining the total iron losses is to

determine the friction losses, and to subtract these losses, together with the calculated copper losses, from the total no-load watts required to run the motor light. If either of the Blanc or Benischke methods is used, the true friction losses should be obtained by retardation curves as described, which, incidentally, gives the rotor losses as a separate item.

By coupling the induction motor to a direct-current machine, so that it may be driven with open rotor circuit, a very complete separation of the no-load iron losses may be obtained.

When running below synchronism with the rotor circuit open, the iron losses in the rotor will increase with decrease of speed. Consequently, by gradually increasing the speed of the rotor up to synchronism by means of the continuous-current motor, the watts supplied to the stator of the induction motor will be found to diminish. At synchronism, the only losses in the rotor will be those due to magnetic pulsation in the teeth. At this point also, the direction of the torque due to rotor hysteresis will be reversed. After passing the synchronous speed, this effect no longer tends to drive the rotor, requiring power to be taken for this purpose from the stator; the rotor hysteresis is, on the contrary, supplied from the direct-current machine, and power is supplied to the mains owing to this cause. By making observations of the power supplied to the stator of the induction motor, and of the power spent in driving the continuous-current machine, it thus becomes possible to measure separately the stator iron loss, rotor hysteresis loss, the pulsation losses and the friction. The last-named is obtained by driving the direct-current motor, first coupled to and then uncoupled from the unexcited induction motor. The experiment requires considerable care, but is not difficult to carry out if the ratio of alternating to continuous voltage supply can be kept absolutely constant.

The curves shown in fig. 10 will be understood from the particulars already given. The lowest curve is the A.C. wattmeter reading (corrected for C^2R), the other curves all being D.C. watts supplied to the driving motor.

DISCUSSION.

Mr. W. CRAMP suggested the possibility of taking a retardation and an acceleration curve for a particular case, and then by drawing in all the sub-normals to plot a complete curve of losses, and even of the efficiency for the machine. On fig. 3, if they were to extend the first curve up to full speed, it would be found that the motor had, with what he supposed was normal excitation and normal speed (3·9 amperes, 900 R.P.M.), a loss of 1,500 watts or some 15 per cent. It seemed to him that that was an extraordinarily bad machine. He laid stress upon the simplicity and usefulness of the equation numbered 4. The fact that losses or efficiency could be given in such an easy form, involving only a few careful time readings, and dispensing altogether with the calculation of moment of inertia, was new to him. Referring to fig. 4, showing the retardation and acceleration curves as practically straight lines, he asked if it were not possible to take four readings for any motor coupled to a fly-wheel, and draw in straight lines corresponding to them. If the 20-ampere retardation curve could be taken as a straight line down to the bottom, the taking of the readings would be very much simplified, and in the graphical method which he had just suggested, all the sub-normals for one particular curve would be parallel. In fig. 6, Mr. Smith had some difficulty in accounting for the losses which occurred between retardation and acceleration. Some of those losses might possibly be due to windage. It did not seem to be realised that the windage losses in a motor might be extremely large. The windage on a fly-wheel such as a 9-ft. disk amounted to about 10 H.P. at 500 R.P.M. In the latter part of the paper the methods given and the formulæ did not apply to single-phase motors.

Mr. JULIUS FRITH mentioned a method of separating the losses in a D.C. machine, by taking power curves to run the motor at varying speeds at two inductions, say, at full and at half induction. Both the current and the voltage curves should be straight lines. The slopes of the two current curves being eddy-current losses, the slope of the half-field curve was half that of the full-field current curve; the portion between the base line and the left-hand end of the current curve gave the friction and hysteresis losses, which could be separated out very easily. He had used the retardation method of separating losses at no load with heavier machines, that kept running by themselves for a minute or two, which rendered the fly-wheel unnecessary. For the full-load curves he did not think the author had laid sufficient stress on the question of brushes; he gathered that he used the same brush lead for the retardation and acceleration curves—*i.e.*, when the machine was acting as a motor or as a generator; the power to drive would be very seriously affected by the position of the brushes, which required to be very accurately set, in order not to get very disturbing results by the currents under the brushes. He objected to the author's use of the term "armature drop." Several methods were mentioned of making a rotating field by sending direct current into the slip-rings of an induction motor; but such field might differ from the revolving field caused by the stator currents in having quite a different wave form; and so, whilst giving the same root-mean-square induction, the maximum induction, on which depended the losses, might not be the same at all.

Dr. W. G. RHODES said purchasers did not care at all where the losses occurred, or how they occurred, so that they were not theirs. They wanted net efficiency. The question of allocating the losses depended upon what the machinery was required for—whether it was required to run on light load long, or whether it was required to run on full load entirely.

Mr. C. F. SMITH, in reply, said that the reason why he had not adopted the graphical value of the slope of the curve, and had not used the sub-normal, was that he found he could get more accurate values for the slope of the curve by actually using the curve itself, rather than continuing the tangents as long lines to a considerable distance, where any error would be considerably magnified. Referring to fig. 4, the lines, when fully plotted out on a large scale, were not sufficiently straight to make it possible to determine them completely by taking readings far apart. If the time were taken for the speed to fall from 1,000 to 800, the time intervals would be quite long enough to read accurately, and the curves taken between the points would be sufficiently straight to make it unnecessary to take more than one such reading, at, or near, the working speed of the motor. Regarding the losses shown in fig. 6, he did not think that air friction or windage could possibly account for the difference in the shape of the curves, because at a given speed the windage loss must have been exactly the same when the machine was acting as a generator or as a motor. His experiments were only carried out on one machine; the particular fly-wheel he had available was mounted on bearings which practically made it impossible for any other motors to be put on to it. With regard to the position of brushes, the drop he meant was the difference between the terminal volts and the generated volts, and it might often be more largely due to armature reaction than to actual resistance. In connection with the A.C. experiment, the pulsation losses during rotation were borne by the rotor in the same way as the friction, so that, if the rotor circuit was opened, the pulsation losses were no longer supplied from the stator, and, consequently, the drop in volts was due to friction plus pulsation.

Illumination and Some Illuminants.

IN the course of the discussion on the paper by Mr. J. D. Mackenzie, read before the INSTITUTION OF ELECTRICAL ENGINEERS at Glasgow, on April 9th (see ELECTRICAL REVIEW, April 26th, p. 700), Mr. H. B. MAXWELL said there was no difficulty nowadays in diffusing light so that the intrinsic brilliancy was not uncomfortable to the sight. A holophane globe entirely covering the source of illumination, diffused the light in an absolutely perfect way, and the efficiency came out at about 80 per cent. He did not see how the additional candle-foot was obtained due to reflection; the equation did not refer to spherical candle-power, but in each individual case to the candle-power in any one direction. It was practically impossible to light a shop window displaying goods irregularly with light diffused by reflection, and it was absolutely necessary to put some of the lamps in the line of vision, unless the window was dressed to suit the lighting. The light should not be directly reflected into the observer's eye, but for a large number of cases direct reflection was preferable. Eye strain was due first to the fact of direct reflection, and secondly to the light striking on the paper at the wrong angle. With regard to lighting houses by indirect reflection, the amount of dirt and dead flies in the reflectors was enormous, and the efficiency of such a form of illumination was very low.

Mr. W. A. WILSON remarked that Mr. Mackenzie had said that in an ordinary room the light came in through windows placed at one end and perhaps one side; but that was generally an exigency of circumstances. It might be all right during daylight, because one could not help himself, but most of them would prefer light which did not come from that direction in the evening.

Mr. GEORGE L. BLACK said people who had had the light for four or five years sometimes complained that, when they went home at night, the house was dim and they could not see, but about 10 o'clock the light was better. The reason of this was found to be that in a shop, or warehouse, a man had a tremendous blaze of illumination, and he went home by car with a 32 or 40 C.P. light behind him; he went into the house, where perhaps he had green paper on the walls, and, of course, the light was dim. By 10 o'clock he was accustomed to the dim light, and could see quite well. People were getting accustomed to too much light in their eyes and getting their eyes strained. He had had occasion to send one of his workmen to the Eye Infirmary, and the surgeon had come to the conclusion that the defective vision had been caused by incandescent gas, and explained that he had had his own house fitted with it, and found the eye strain so great that he had had to alter it.

The Chairman (Mr. W. W. LACKIE) said he could remember a man working in a gas office who had a 300-C.P. lamp over his head, and he declared that he had not enough light till it was removed and a 16-C.P. lamp put in its place. It had been found that 5-C.P. per sq. in. of intrinsic brilliancy was about the correct thing, and on an arc lamp the size of the globes gave that. If one put on pear-shaped globes the arc lamp looked poor, because one had reduced it below 5 C.P. per sq. in. He thought the best lighting of halls and churches was not to let the source of light come between the spectator and the speaker. The result was that anyone looking forward saw no light and yet the place was very well lit. The speaker got the whole of the light in his eye, but he would get it in any case, and he was no worse off than in the ordinary way.

Mr. MACKENZIE, in reply, said that holophane globes would require a paper by itself to deal with them. With regard to perfect diffusion, they did not want it in a shop window, because the goods would appear too flat. On a drawing board one was working with a flat surface in any case, and although indirect lighting was used for drawing office work, there was an objection, due to the fact that it might be too flat, and consequently there was a strain on the eye in endeavouring to distinguish lines on the paper. He admitted that reflecting surfaces would get dirty, but ordinary lamps and house windows would also get dirty, and had

to be cleaned occasionally. The paraffin lamp gave a very yellow flame, and as the eye could stand more of yellow light than ordinary light the effect was not so trying. Mr. Black had remarked upon the excess of illumination that people had during the day and their going home to a less brilliantly illuminated room; that was simply an example of what he had been trying to say.

The Faraday Society.

METALLIC CALCIUM AS A REDUCING AGENT.

DR. F. M. PERKIN has been making some interesting experiments with calcium, now, it must be remembered, an industrial product of growing importance, thanks to the electric furnace, to see whether it can be used in the same way as aluminium for the preparation of chromium, ferro-silicon, and other metals and alloys, and his preliminary experiments were embodied in a Paper read before the Faraday Society on the 28th ult. Speaking generally, calcium is a far more powerful reducing agent than aluminium, so much so, that in many cases the action is too violent to be altogether pleasant. Thus, Dr. Perkin tried reducing ferric oxide with calcium burnings, igniting the mixture—as is done with thermit—with a fuse of aluminium and barium peroxide; the mixture was ejected with much fuss and ceremony from the crucible. The reduction can, however, be brought under control by adding suitable diluents, such as calcium fluoride of lime, and the action is one which has practical possibilities as soon as calcium becomes cheap. At present it is nearly twice as dear as aluminium.

An interesting reduction is that of boron trioxide, because it appears that aluminium will not reduce this refractory oxide. Calcium, however, does so with the greatest ease, a fuse of calcium and sodium peroxide being employed to ignite the mixture. Here, again, it was necessary to add 5 to 10 per cent. of lime in order to reduce the violence of the reaction to comfortable limits. Unfortunately, Dr. Perkin has not, up to the present, succeeded in making pure boron by this method, his product always containing 20 per cent. or more of calcium, probably present as calcium boride. When a rightly proportioned mixture of borax and calcium is carefully dried and ignited, the reaction proceeds without undue violence, and on treating the resulting mass with hydrochloric acid, brown amorphous boron is obtained almost up to the theoretical quantity. The boron still contains calcium, but it can be used for preparing boron chloride and other compounds.

It was found that silica, in the form of sand, when reduced with calcium, yielded not pure silicon, but calcium silicide. Incidentally it was pointed out that aluminium and sand cannot be made to react at all, but Mr. F. E. Weston said he had succeeded in reducing silica in the form of Kieselguhr by means of aluminium, and it is therefore evident that the state of division of the materials in these experiments is of the utmost importance. Strange to say, when sulphur is present, even sand can be reduced by aluminium.

Other metallic oxides experimented with were those of manganese and chromium, and in both cases the metals were obtained, and the reactions brought under control by having calcium fluoride present as a diluent. Galena was also tried, but unlike, in the corresponding aluminium reaction, metallic lead was not obtained; the probably calcium thioplumbate. Stibnite, in like manner, was reduced, not to metallic antimony, but to a similar compound. In all these experiments, the crucibles had to be specially lined, generally with a paste of slaked lime and sodium silicate, else the products could not be removed.

In the discussion which followed the reading of the paper, Mr. F. E. WESTON stated that he had recently been using aluminium for the reduction of titanium compounds.

The paper by Mr. F. H. CAMPBELL, "Contributions to the Chemistry of Gold," contains much valuable matter, but is chiefly of pure chemical interest. The author has been experimentally studying in the laboratory of Prof. Abegg, at Breslau, the various halogen compounds of gold, the conditions under which they form, and the ionic state in which gold enters into them when in solution. The normal potential for the tendency Au $\longrightarrow$ metallic gold was calculated and found to be + 1·5 volts against the hydrogen standard.

The small affinity between gold and iodine, the tendency to form a complexion with iodine, the high oxidation potential of gold ions, and the very low solubility product of Au_2O, all agree to confirm the assumption that gold forms very weak positive ions.

Prior to the ordinary meeting, the annual general meeting of the Society was held, at which the report of the Council and the balance-sheet were duly approved, and the following officers and Council elected for the session 1907-8:—

President.—Sir William Perkin, F.R.S.

Vice-Presidents.—G. T. Beilby, F.R.S., R. A. Hadfield, Prof. W. Hittorf, Sir William Huggins, O.M., F.R.S., Prof. A. K. Huntington, Prof. A. Schuster, F.R.S., Prof. J. J. Thomson, F.R.S.

Treasurer.—F. Mollwo Perkin, Ph.D.

Council.—A. C. Claudet, S. Z. de Ferranti, F. W. Harbord, R. S. Hutton, T. M. Lowry, W. Murray Morrison, J. Swinburne, F.R.S., N. T. M. Wilsmore, Prof. E. Wilson, J. L. F. Vogel.

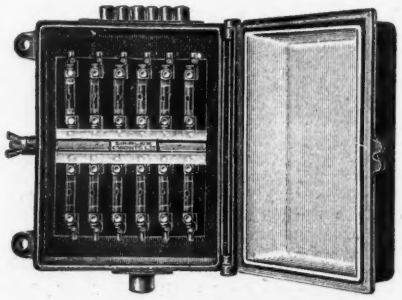
Canterbury Lighting.—The T.C. has applied to the L.G.B. for a loan of £4,000—£2,000 for street lighting, and £2,000 for house connections, meters, &c.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Simplex Watertight Iron-Clad Fuseboard.

This new type of board, which is being supplied by SIMPLEX CONDUITS, LTD., of London and Birmingham, embodies in its designs several important features. The cast-iron box has a deep cover which is fitted with a flange and rubber band in order to obtain a watertight job when closed, and front connections are arranged for throughout.

The fuses, which are of the Simplex patent "blotter" type, are fitted with end shields to prevent any accidental contact when

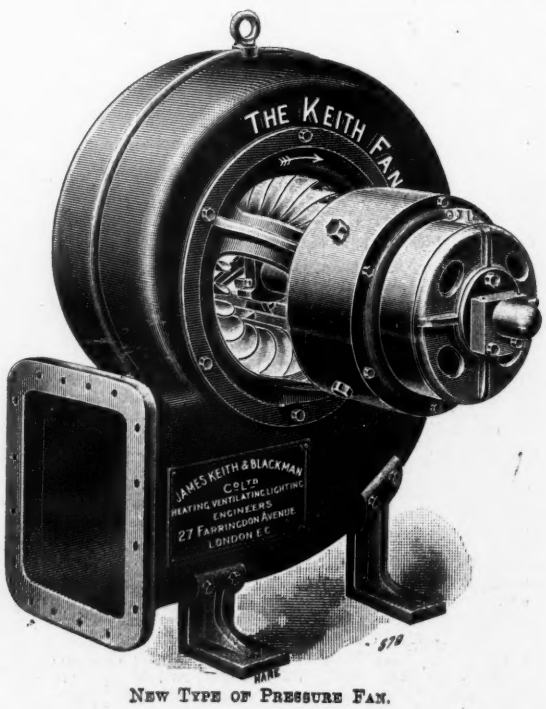


SIMPLEX IRON-CLAD FUSEBOARD.

replacing. The two poles mounted on separate slate bases are fixed to the case through insulating battens, so that at no place is the slate less than 1¼ in. away from the iron case; thus obviating surface leakage and any chance of an arc on to the cover. These boards are made in all sizes up to 8-way, and a glass inspection front can be provided if desired.

Keith Pressure Fans.

In the catalogue of the JAMES KEITH & BLACKMAN CO., LTD., of 27, Farringdon Avenue, E.C., are given particulars of the Keith pressure fans which form a new departure in their business. These fans are designed for all classes of ventilation, as well as the removal of dust apart from chips or shavings, and they are adapted



NEW TYPE OF PRESSURE FAN.

for blowing and exhaust work of various kinds, forced draught to steam-boilers; also induced draught, and the handling of hot gases, with a modification in the construction. Special attention has been devoted to securing perfect balancing of the wheels, which are claimed to be of exceptional strength in design and construction; they run solely from the centre, so that they can be driven with safety at almost any practicable speed, there being neither exceptionally narrow blades, nor intricate narrow airways to get choked.

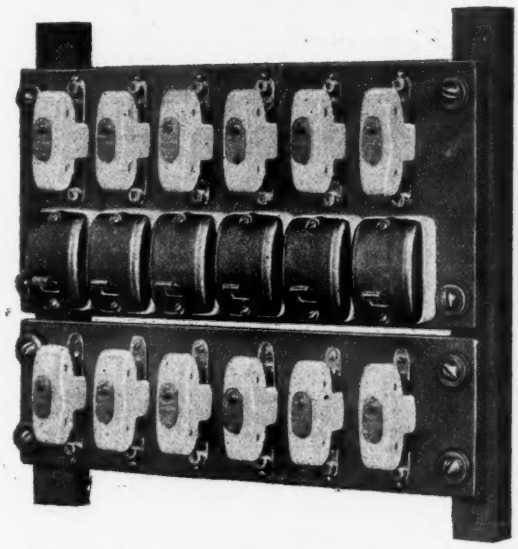
The fans can be used for the majority of applications necessary

to the various manufactures to be met with in all classes of business. They are most efficiently used for suction purposes, and may be arranged with single or double inlets, and with air conduits to suit the conditions. The casings proper of these fans are formed of one piece turned true on both sides. This does not necessarily mean that the fans must have cast-iron cases, as, when desired, they can be built of wrought iron or mild steel. For the handling of very hot gases, and induced or forced draughts, it is necessary to provide an extended surface water-jacket arranged around the bearings, there being no difficulty in providing these. The fans are capable of working up to a resistance of 6 in. water-gauge. In the accompanying illustration we show one of the fans electrically-driven.

"Slipper" Switches.

Messrs. Dorman & Smith, of Ordsal Electrical Works, Salford, have issued a price list of "Slipper" type switches from which it appears that suitable Pateræ are stocked for mounting the switches, as well as cast-iron boxes, one-way, two-way, and three-way, for conduit installation. Particulars and prices of these accessories are given.

It is pointed out that the neat and compact form of the "Slipper" switch renders it particularly suitable for use on distribution boards,



Compact Distribution Board, fitted with "Slipper" Switches and "Damper" Fuses.

and it is worthy of mention that the board shown in the accompanying illustration, comprising this type of switch with D.P. "damper" fuses, measures only 11 in. by 8½ in.

Messrs. Dorman & Smith inform us that, in view of the gratifying demand for the present 2-ampere switch, they intend to place a larger size of the same type, capacity 6 amperes, on the market very shortly.

PARLIAMENTARY.

British Consular Information.—A question was asked in the House of Commons on the 10th inst. as to whether a merchant in the United Kingdom applying for assistance to a British Consul on the Continent is referred to the Board of Trade instead of being communicated with direct, and if so, the reason therefor. Mr. Runciman, in reply, said it was desirable that British traders should, before addressing inquiries to his Majesty's Consular officers, ascertain from the Commercial Intelligence Branch of the Board of Trade whether the information is available there. Consular officers supply this branch with information, in order that it may be generally and quickly available. It seems that when a Consular officer receives a direct inquiry from a British merchant he forwards his reply through this branch, which transmits it to its destination after taking note of its contents for the benefit of British trade in general. Many merchants complain that this method does not facilitate the direct communication of complaints, but Mr. Runciman said that, after consideration of the circumstances, the arrangement was regarded as the best for British trade in general.

Third Readings.—In the House of Lords on June 10th, the following Bills were read a third time:—Electric Supply Corporation Bill; the Electric Lighting Provisional Orders (No. 1) Bill.

In the House of Lords on June 3rd the Aberdeen Corporation Electricity Bill was read a third time.

Electric Lighting Provisional Orders (No. 5) Bill.—This Bill, which confirms Provisional Orders granted by the Board of Trade in respect of Minehead and Dunster, Rhymney Valley, General Electric Supply Co., and St. Albans and Districts, was before the Unopposed Bills Committee of the House of Commons on Thursday last week, and was reported for third reading.

Portsdown and Horndean Light Railway (Extension, &c.) Order.—The Light Railway Commissioners have submitted the above to the Board of Trade for confirmation.

Electric Lighting Provisional Order (No. 2) Bill.—On Tuesday this Bill came before the Earl of Onslow's Select Committee of the House of Commons. The measure confirms a provisional order made by the Board of Trade in respect to the Rural District of Cork. Formal evidence having been given by Mr. Morris, the Bill was ordered to proceed.

Middlesbrough, Stockton-on-Tees and Thornaby Tramways.—This Bill, which is promoted by the Imperial Tramway Co., came before the Earl of Onslow's Select Committee of the House of Lords on Tuesday. The Bill authorises the construction of a new tramway in Middlesbrough. Formal evidence was given in support of the measure, and it was ordered to proceed.

Electric Lighting Provisional Order (No. 4) Bill.—This Bill came before the Earl of Onslow's Select Committee of the House of Lords on Tuesday, and was ordered to go forward for third reading. The Bill confirms a provisional order granted to George Balfour, 9, Cloak Lane, London, electrical engineer, in respect of the Burgh of Arbroath.

PATENTS IN 1906.

The report of the Comptroller-General of Patents for 1906, in referring to the trend of invention during the year, states that the competition between gas and electricity for lighting purposes still continues. The chief developments in gas lighting relate to inverted incandescent burners and the adaptation of ordinary upright fittings for use therewith. In electric lighting the growth is due mainly to the introduction of metallic filaments in incandescent lamps, and the use of metallic substances in electrodes of arc lamps. The accident at Handcross Hill was followed by many applications for emergency brakes for motor-cars, as was also the case in connection with tramcars after the accident at Highgate. The fatal accidents on railways at Merstham, Rugby and elsewhere, appear to have incited inventors to devise systems for locking the doors of a train in motion, either automatically or by means under the control of the guard or driver. The number of applications for patents in recent years and of patents granted are set forth below :—

Year.	No. of applications.	No. of patents granted
1896...	30,193	12,473
1897...	30,952	14,210
1900...	23,924	13,170
1901...	26,788	13,062
1902...	28,972	13,764
1903...	28,854	15,718
1904...	29,702	15,089
1905...	27,577	14,786
1906...	30,002	14,707

It will be seen that the increase in the number of applications has brought the total for 1906 nearly to the level of the record years of 1896 and 1897, whilst the patents sealed in 1906, although less than in the three preceding years, were considerably more numerous than in 1896 or 1897. The applications made last year comprised 18,547 from persons resident in England and Wales, as compared with 17,448 in 1905; 1,308 and 1,304 respectively from Scotland, 378 and 353 from Ireland, 11 and 12 from the Channel Islands, and 2 and 4 respectively from the Isle of Man. As to applications from abroad, Germany headed the list for the first time with 3,257, as against 2,527 in 1905, and the United States receded to the second position with 3,010 in 1906, as contrasted with 2,927 in the previous year.

The Comptroller states that the investigation under Section 1 of the Patents Act, 1902, so far from having a deterrent effect upon inventors, has been accompanied by an immediate and substantial increase in the number of complete specifications filed. It is therefore assumed that inventors generally have appreciated the benefits which the official search has conferred upon them. As to the working of this particular section of the Act in 1905, it appears that, in respect of the 27,577 applications made in that year, 16,746 complete specifications were filed, and the investigation required by the Act showed that, of the 15,369 cases finally accepted, 1,308 were reported by the Examiners as having been anticipated wholly, 8,238 were reported as having been anticipated in part, whilst in 5,823 cases no anticipations were reported. No less than 8,785 specifications out of the

15,369 cases accepted were amended as the result of the official investigation. In all these cases, the effect of the amendment was to cause the specification to define more clearly and closely the nature of the invention and the scope of the patent to be granted, having regard to the condition of the art, as disclosed by the prior specifications found by the Examiner during his investigation.

The question of hearings before the Comptroller in connection with oppositions to the grant of patents, oppositions to proposed amendments of specifications, &c., is also referred to in the report. It appears that, in the two years since the Act of 1902 came into force, the number of hearings fixed has been 5,192, but 2,081 of these were rendered unnecessary by the abandonment of the application or amendment of the specification by the applicant. In all the remaining cases formal decisions were given by the Comptroller or his deputies, and only in five cases was an appeal made to the Law Officer. It is considered that these figures indicate clearly that the official requirements, made in consequence of the official investigation as to prior patenting under the Act of 1902, have not, on the whole, been regarded by the applicants for patents as unreasonable. The figures also demonstrate the correctness of the view taken by Sir Edward Fry's Committee, who, when recommending the official search, expressed the opinion that the scheme would be highly beneficial to honest and *bona fide* applicants, whilst it would tend to discourage the taking-out of patents for objects other than the protection of a real invention.

LEGAL.

HORNSBY *v.* BABCOCK & WILCOX.

JUDGMENT.

IN the Chancery Division of the High Court of Justice, on Tuesday afternoon, June 11th, Mr. Justice Neville, after a hearing of nine days, gave judgment in this case.

His LORDSHIP said: In this case Richard Hornsby & Sons, Ltd., are suing Babcock & Wilcox, Ltd., seeking specific performance of certain heads of agreement, dated May 25th, 1906, for the sale by Hornsby & Sons, Ltd., to Babcock & Wilcox, Ltd., of "the complete water-tube boiler business of Hornsby's" at a certain price, which is given approximately and divided into particular items afterwards. The defence to the action is two-fold, or, I think I may say, threefold; first of all, that the document was obtained by misrepresentation of facts; secondly, that the document itself came into existence in the course of negotiation only, and was not intended to be a definite agreement between the parties; and, thirdly, if it was so intended, it has not succeeded in its purpose, inasmuch as it is too indefinite to be given effect to. No question arises in this case as to whether the appropriate remedy is specific performance or damages, because the defendants say that if it is a contract by which they are bound at all, they would prefer that the relief should be by way of specific performance rather than by damages.

The first matter which I have to consider, upon which a great deal of evidence has been given, is the question of whether misrepresentations were made by the plaintiffs or their agents in respect of the subject matter of the property agreed to be sold. With regard to that, the question really depends upon a single issue of fact, that is whether a certain document of May 10th, 1906, of which what purports to be a copy is produced, was or was not the document which was submitted to and received by Mr. Rosenthal on behalf of the defendants shortly after that date. It is alleged and, I think, satisfactorily proved that the original document itself was destroyed; and the circumstances under which that document came to be destroyed have been proved by letters passing between Mr. E. P. Simpson and Mr. Carter. I may say at once that, although it is alleged that Mr. E. P. Simpson was the agent of the plaintiffs, I see no grounds whatever for that suggestion, and after hearing the evidence I am satisfied that although Mr. E. P. Simpson's powers were of the most limited description, and he acted merely as negotiator on the one side, the side upon which he did act as negotiator was the side of the defendants; Mr. Carter acting in a similar capacity for the plaintiffs. I think there is no pretence for the assertion that Mr. Simpson was in any sense the agent of or representing the plaintiff company.

The important question, as I said, is whether or no the document, a copy of which or what purports to be a copy of which is produced, was or was not the document which came into Mr. Rosenthal's hands and upon which he made notes. It is admitted that he did make notes upon the document which came to him, which he agrees was dated May 10th, but he declares that the document which he received on May 10th was a different and dissimilar document from the document which the plaintiffs allege they sent, and of which they produced a copy. If the letter of May 10th, a copy of which is produced, was the letter sent to Mr. Rosenthal, then it seems to me that the question of misrepresentation is at an end, because I think the particulars given in the sheets which were annexed to that letter quite clearly show what the subject matter of the business proposed to be sold by Hornsbys to the defendants was, and what were the agreements and the licences which had been entered into in respect of it.

Now I have proceeded upon the construction of the agreement only in coming to the conclusion, which I have done, that the heads of agreement were intended to be a binding agreement between the parties. They were not, it is true, intended to be the final form which the agreement was to take, because the matter necessarily went to the solicitors on certain points; and undoubtedly it was in the contemplation of both the parties that an agreement in legal form prepared by the solicitors of both parties should be executed. With regard to one provision certainly, that is, as to the covenant not to carry on business, the form of that covenant was to be settled by the solicitors, and I may dismiss that by saying that this was settled in the drafts which have passed between the parties. Although I am relying only upon the form of the agreement itself, I think it became quite clear from what the parties said that they looked upon it as an agreement which bound them from the date of its signature. I notice that in Mr. Roberts's letter about that time, he talks about the immediate endorsement of the document, and although it is quite clear that that did not mean the mere transference to parchment of the words of the heads of agreement, I think it is equally clear that he had no idea in his head that there was to be any difference made between the parties as to the matters which they had agreed on; and I also notice that in the letter of Mr. Nicholls, the solicitor for the defendants, on July 23rd, he proceeds upon the basis of the construction to put upon the heads of agreement themselves in arguing with the solicitors on the other side as to the form which the ultimate agreement ought to take.

The matter was submitted to the solicitors, and I think that the difficulty between the parties has, to a great extent, arisen from the fact that, instead of converting the heads of agreement into a formal document, a very substantial alteration of the wording of the agreement was introduced; and although I am quite sure that it was done with the best intentions, I think it had an unfortunate result, because I believe that the parties knew what they had agreed to, and supposed that they had given expression to that agreement in their heads of agreement. The reason why I say it was unfortunate, is that the result of it was that the matter dragged on from May 25th, when the heads of agreement were signed, until the end of July. Mr. Rosenthal naturally was in no hurry about the matter, because Hornsbys had given hostages which put them into a position from which there was no escape. They had, in accordance with what I believe to be the terms agreed between the parties, handed over orders which they had received in respect of their business to the purchasers, and they had also terminated their arrangements with their agents, at the request of Mr. Rosenthal, on behalf of the defendants. The result of this long delay was, I think, that Mr. Rosenthal became dissatisfied with the bargain which he had made, and on July 10th he first of all raises an objection to the value of what he was getting. He is writing to Mr. Simpson, and he makes a complaint with regard to the Bigelow agreement:—"We judged of this Bigelow agreement from the original proposition submitted to us, in making the deal. We did not then know that the Bigelow agreement is so worded that it cannot be terminated." That was, in my opinion, a wholly unsubstantial objection on the part of Mr. Rosenthal. His suggestion that licences granted by patentees are so generally determinable upon short notice to the licensees was disposed of by his witness, Mr. Dewrance. I cannot remember his exact words, but obviously he did not take the same view, and, indeed, nobody with the slightest knowledge of licences and patents of this sort could for a moment believe that licensees could be obtained who would embark upon the expenditure of erecting plant, and so on, for the purpose of manufacturing on the terms that they might have their business terminated upon short notice. Therefore, I think that Mr. Rosenthal's objection to the Bigelow agreement on July 10th was a mere excuse. In the same letter he says that he assumed that the assignment of the American patent must be of some value. That assumption, I think, was entirely unwarranted. It was only one of the numerous assets which were to be passed from the plaintiffs to the defendants, the purchasers of the business, and in a certain sense there was some value attached to it in his hands because, inasmuch as he desired as far as possible to determine a business of this kind in making these upright boilers in favour of his own manufacture, if by any means that Bigelow agreement did become terminated, then, of course, it would be in his power not to grant any further licences, and to put an end to the business which had been carried on under that patent. However that may be, it is perfectly certain that the vendor of a business of this sort does not warrant that every asset which he purports to transfer is of pecuniary value, or of any value, to the purchaser. So far on the 10th.

Later on another objection was raised, and that was with regard to what has been spoken of as the Westgarth agreement. Whether Mr. Rosenthal's attention originally was directed to the fact of the existence of a concurrent right on the part of Messrs. Richardsons, Westgarth to manufacture these boilers south of an imaginary line drawn across the north of England, I, of course, cannot say, but, undoubtedly, if he had read the letter which, I think, he received on May 10th, he would have been supplied with the necessary information on that point. However that may be, whether he originally read the document, or whether he did not pay sufficient attention to it in the first instance, I cannot say, but he ultimately succeeded in persuading himself that the proposition which he had received contained no mention of the fact that the Westgarth agreement gave concurrent rights in the south of England, and he

supposed that he understood that their rights were limited solely to the business in the north of England. Having once persuaded himself of that, the rest, of course, followed easily and naturally. If he was wholly uninformed upon the point, it was obvious that it could not be contained in the letter which he received on May 10th, and, therefore, when a copy of the letter of May 10th is produced which shows that the matter was set out and mentioned then, he says that could not be the letter which he received on May 10th; and having persuaded himself that that could not be the letter of May 10th which he received, he very easily persuaded others who had seen the letter to be of the same opinion as himself. I may say in passing that the witnesses who were called to declare that the letter of May 10th was not the letter, a copy of which was produced, themselves had no definite recollection of the letter which they allege they had received, one of them thinking that it was on two sheets pinned together, another thinking that it was on the inside of an ordinary sheet of paper—a difference, I may remark, which is of immense importance when you are setting up a supposed recollection of the appearance of a document as against the form which the document must have taken when a copy is produced. However, the unfortunate part of the matter is that, having come to this conclusion, Mr. Rosenthal necessarily made imputations upon the honesty of the persons with whom he had dealt, for which, in my opinion, there was not the slightest foundation. I think that Mr. Roberts, Mr. E. P. Simpson, Mr. Carter, Mr. Payne, and Haynes were all of them witnesses of truth, and that the facts to which they depose are substantially—I do not say in every minute particular, but substantially—accurate and true. The copy seems to have come into existence in a perfectly normal way, and I have not the slightest doubt that although they do not think so at the present time, the document which the witnesses on the other side did see on May 10th, the document which Mr. Rosenthal had for some time in his possession, though he ultimately gave it back to Mr. E. P. Simpson, was none other than the document a copy of which was produced on behalf of the plaintiffs. I may say, before I leave this point, that the suggestion made by Mr. Rosenthal involved the most elaborate and extensive fraud on the part of the persons with whom he had been dealing, and I must add that I never knew a case in which fraud of such a kind was imputed on so little foundation and unsupported by any reliable testimony at all.

That disposes of what really was the only issue of fact in the case, and brings us back to what I think is the main point, and that is whether the document is one which is binding between the parties, or whether it is of too uncertain a character to involve them in legal or equitable liability. I confess that I felt some difficulty on minor points with regard to the agreement. That the heads of agreement were intended, not by way of negotiation but by way of immediate contract, in certain particulars at all events, I think is made quite clear by several of the clauses in it, notably Clause 11, whereby the plaintiffs agree "to at once give notice to their agents to terminate any existing agency arrangements"; and I think it is quite clear upon the terms of the document, and it certainly was the view of the parties themselves, that "at once" meant upon the signing of the agreement, and not at any future date.

The real question is, whether the price is ascertainable at which the business is to be sold. I think that there is no substantial difficulty in ascertaining the price of all the matters enumerated in Clause 2, except with regard to the loose tools and patterns. That did for some time give me considerable difficulty, but, on closer examination of the document, I think that the price of the loose tools and patterns can be fixed, and I think that it can be ascertained, and that the Court is entitled to ascertain what were the loose tools and patterns which the defendants could make use of; and I think that for those loose tools and for those patterns they have to give a fair value, not exceeding the £2,500 and the £850 mentioned in the schedule of prices.

With regard to the plant and the stocks, that is a matter with regard to which there is to be a preliminary transaction, because it is left to Mr. E. P. Simpson to inspect and select for delivery the plant, and "approve the loss estimated by Hornsbys upon the plant which neither Babcock & Wilcox nor Hornsbys can make use of"; and I understand that Mr. E. P. Simpson is ready and willing to perform the duties imposed upon him by both parties under this agreement. I think, therefore, that he must proceed with that inquiry in the first instance, and that, if necessary, there must be an inquiry as to the loose tools and patterns which Babcock and Wilcox can make use of, and also as to the value to be paid for them. I think, therefore, that the present decree ought to declare the right of the plaintiffs to specific performance of the heads of agreement, except with regard to the last clause of paragraph 14 of the agreement, which is obviously left undecided and unsettled by the parties; and I think the best way will be to give liberty to apply with regard to it.

Mr. JENKINS: I should like a declaration, and I do not suppose my learned friend would have any objection, declaring that the agreement should be specifically performed, and I think we had better take a declaration according to the true construction of the agreement with regard to the tools and patterns, following what your Lordship has said.

Mr. Justice NEVILLE: Yes.

Mr. JENKINS: I think my friend would not object to that. Then we have already proved the values of the home stocks and the foreign stocks; and with regard to Mr. Simpson, of course I agree it stands over. We have proved the value of the home stocks and the foreign stocks on two figures which will be found in pages 71 and 74 of the shorthand notes.

Mr. Justice NEVILLE: Very well; they are to be your own valuation.

Mr. JENKINS: Yes. I should ask for a declaration that they are liable to pay the sum of £5,000 mentioned in the agreement.

Mr. Justice NEVILLE: "Cash," which I take to mean goodwill.

Mr. JENKINS: Yes; and £9,751 16s. 10d. in respect of home stocks and £5,551 7s. 6d. for the foreign stocks. We know how the plant should be dealt with. Then it was admitted that if I was entitled to specific performance, I was also entitled to an inquiry as to what damage I have suffered by their refusal to carry out the agreement.

Mr. Justice NEVILLE: Yes.

Mr. JENKINS: I ask that the costs of the action up to judgment should be given to me, and the counterclaim dismissed with costs.

Mr. Justice NEVILLE: Yes.

Mr. JENKINS: Any subsequent costs, I suppose, will be reserved in the usual way?

Mr. Justice NEVILLE: Yes. I think Mr. Macnaghten had better sign the minutes.

Mr. JENKINS: If your Lordship pleases.

TRAMCAR ACCIDENT CLAIM.

AT the Bacup County Court on Tuesday, 11th inst., Mrs. Tattersall, of Haslingden, was awarded £40 16s. damages against the Rossendale Tramways Co. for personal injuries sustained at Cloughfold, near Bacup, on February 19th, when she was a passenger in one of the company's cars which collided violently with another, by which she received a severe shock and had been laid up for seven weeks. It was given in evidence by Dr. Davidson, of Haslingden, on behalf of the plaintiff, that she suffered from valvular disease of the heart caused by shock due to the accident and he cited a parallel case at Sunderland in which organic disease of the heart had been set up by shock.

BUSINESS NOTES.

Bennis Stokers.—A large number of contracts have been secured during the last six weeks by MESSRS. ED. BENNIS AND CO., LTD., for their machine stokers and self-cleansing compressed air furnaces. These are for service in a variety of manufactories all seeking to secure economy in the boiler house—such as colliery proprietors, cement manufacturers, flour millers, cotton manufacturers, silk spinners, bleachers, dyers and electricity supply corporations. The contracts secured are from France, Scotland, Wales and England. More than 60 per cent. are repeat orders. From a list of the order, which is now before us, we observe that they include for the Carlton Main Colliery Co., Frickley Colliery, 12 stokers and C.A.F. to Lancashire boilers, and complete coal and ash handling plant (repeat); and for the Coventry Corporation Electricity Department, Coventry, mechanical coal and ash handling plant, with overhead coal and ash bunkers and automatic weighing apparatus, to cost £3,279; also a repeat order for six Bennis-Miller-Bennett chain-grate stokers.

Balcke Cooling Towers.—We understand that MESSRS. BALCKE & CO., of London, are very busy with water-cooling towers, amongst orders at present in hand being the following:—

Metropolitan Railway Co., power station, Neasden, for two duplex chimney cooling towers for 410,000 gallons.

Sunderland Corporation (through Messrs. Willans & Robinson, Ltd.), for two chimney cooling towers for 150,000 gallons.

Sunderland Corporation, new interior for chimney cooling tower, 125,000 gallons.

Wm. Beardmore & Co., Parkhead Steel Works, Glasgow, for one chimney cooling tower for 118,000 gallons.

Stewarts and Lloyds, Ltd., Mossend (through Mr. P. J. Mitchell), for one chimney cooling tower for 118,000 gallons.

D. Colville & Sons, Ltd., Motherwell (through Mirrlees, Watson & Co.), for one chimney cooling plant for 360,000 gallons.

Central London Railway, power station, Shepherd's Bush, for one brick chimney cooling tower for 200,000 gallons per hour.

The Lighting at Olympia.—With reference to our remarks in last week's issue under the above heading, we are informed by MESSRS. D. SANTONI & CO. (1906), LTD., that 16 of their "Santoni" flame lamps were employed for lighting the arena on the occasion of the recent Naval and Military Tournament. Furthermore, 32 of the same type of lamp are being used at the Horse Show this week. These lamps are manufactured at the company's London works.

Escher-Wyss Turbines.—In connection with the reports of the British Aluminium Co. and the Rio de Janeiro Tramway, Light and Power Co., published in our issue of June 7th, we understand that the water turbines for the generation of power in both these large schemes were supplied by MESSRS. ESCHER, WYSS AND CO., of Zürich, the outputs being respectively 30,000 and 57,000 H.P. Moreover, the same firm have supplied the machinery for the other two companies of which mention is made in the reports. The Neuhausen Aluminium Co. have turbines manufactured by Escher-Wyss, and giving 70,000 B.H.P., and the same works supplied the hydraulic machinery for two units of 4,300 B.H.P. each for the Sao Paulo Tramway Co.

Dissolutions and Liquidations.—IMPROVED ELECTRIC SUPPLIES, LTD.—The first meeting of creditors in this matter is to be held on Tuesday next, 18th inst., at Bankruptcy Buildings, Carey Street, W.C. The summary of the statement of affairs shows liabilities amounting to £6,609, and an estimated deficiency, as regards creditors, of £5,638. The deficiency as regards contributories, is £10,000, representing £5,000 in "B" shares, and £4,993 in ordinary shares issued fully paid to vendor, and £7 called up on seven £1 shares. There is thus a total deficiency of £15,638. The company was promoted in October, 1905, to acquire the goodwill and assets of the Improved Electric Glow Lamp Co., Ltd. (in liquidation), and to carry on the business of electricians and electrical engineers with H. H. Thompson as managing director at £450 per annum. A first debenture of £4,000 was issued to W. Chamberlain, who had acquired from the old company the goodwill and other assets of that company in consideration of his undertaking to pay in full the claims of creditors (£4,808), and discharging a debenture debt of the old company of £4,000. Chamberlain also paid for £2,500 second debentures in cash, less a deduction of £985 in respect of debts of the old company extinguished by him. According to an approximate balance-sheet made up to June 30th, 1906, there was a net loss of £1,592 incurred by the company up to that date. The assistant official receiver (Mr. W. J. Warley) in his statement, says that the failure is attributed by Thompson to want of capital. In the opinion of Cleveland (another director), the company purchased the assets of the old company at too high a figure, and the vendor (Chamberlain) undertook too large an obligation in agreeing to pay 20s. in the £ to the creditors of the old company, the result being that the company had an insufficiency of capital to carry on business. Chamberlain considers that the opinions of Thompson and Cleveland as to the immediate cause of the failure appear to amount to the same thing, viz., want of working capital, and in those opinions he concurs. The receiver took steps to obtain a purchaser for the business, and two offers were received. The offer of Messrs. Laing, Wharton and Cunnington was accepted, subject to the sanction of the Court. It was for £8,250 (£3,500 in cash and the balance in instalments at three and six months, secured by bills), and the retention of the book debts. The sanction of the Court was duly obtained, but difficulties have since arisen, and the purchase has not yet been completed.

WELDITE, LTD.—This company is winding up voluntarily with Mr. G. B. George, 11, Lansdown Road, West Didsbury, near Manchester, as liquidator.

H. and T. DANKS, LTD., Crown Boiler Works, Netherton.—This company is being wound up voluntarily for purposes of re-construction, Mr. A. E. Percy, Priory Street, Dudley, is liquidator.

Russia.—A Consular report from Baku draws attention to the great demand which exists for electric apparatus for lighting, bores, &c.

Finland and Sweden.—A company has been registered in Berlin, under the name of Elektricitäts Werke, Abo A. G., Albert Hempel manager, with a capital of £60,000, for erecting, &c., electric lighting and tramway works in Sweden and Finland.

For Sale.—THE SOUTH AMERICAN LIGHT AND POWER CO., LTD., of Lombard Street, E.C., is offering a 360-B.H.P. four-cylinder vertical gas engine and 240-KW. two-phase alternator and exciter (2,300 volts) for sale. An illustration of the plant appears in our business pages.

Canadian Electrical Trade.—A correspondent at Ottawa writes:—"The demand for electrical machinery is good. Electrical manufacturers and dealers report numerous orders for power and lighting plant machinery. The rapid growth of the towns in Western Canada, which are established almost weekly, one place or another installing electric light systems or street railways, is giving the Canadian electrical manufacturers all they can do. Then the rapid growth of hydro-electric power development in the East calls for large quantities of electrical goods. As far as Ontario is concerned, it is rapidly making an epoch. It is now, or very soon, the 'Electric Age,' so far as the Province of Ontario is concerned."

The project of supplying the towns in Western Ontario with electric power from Niagara Falls is now almost complete. Representatives of twelve municipalities concerned in the scheme met in Toronto last week, and approved the terms of the Ontario Power companies' tender accepted by the Government, and the Hydro-Electric Power Commission, endorsed the latter's policy generally, and gave the Commission a mandate to proceed with the work of surveying and preparing the plans. The municipalities represented were Toronto, Hamilton, London, Woodstock, Brantford, Guelph, Berlin, Ingersoll, Stratford, Galt, Waterloo and Tilsonburg.

Contracts for the Edmonton, Alta., electric railway have been let as follows:—For gas engines, Allis-Chalmers Co., Milwaukee; producers, Power and Mining Co., Milwaukee. The track and power house will be built by the city. The line will be 7 miles long. Surveys are completed, and right of way secured.

The Brandon, Man., Electric Light Co. has voted $21,000 for extensions to its plant.

An electrical engineer has been engaged to prepare plans for the development of water-power on the Little Saskatchewan River at Minneddosa.

Work on the Government telephone line between Lacombe and Stettler, Alberta, has been started, and the line between Wetaskawin and Drysland is also under construction.

Fire.—On Saturday last a fire occurred at MESSRS. DOULTON & Co.'s pottery works in Lambeth.

British Westinghouse Capital Reduction.—The petition for reducing the capital of the British Westinghouse, &c., Co., Ltd., from £3,250,000 to £1,875,000 is to be heard on Tuesday, July 2nd, before Mr. Justice Swinfen Eady.

Bankruptcy Proceedings.—R. S. BLACKBURN, electrical engineer and contractor, Osborne Street, Hebden Bridge.—A receiving order was made at Burnley on June 4th on debtor's own petition.

F. E. WILLIAMS, electrical engineer, Coventry Road, Birmingham.—June 24th is the last day for receipt of proofs for intended dividend, by A. S. Cully, official receiver, 191, Corporation Street, Birmingham.

T. E. RAYMOND PHILLIPS, electrical engineer, Liverpool.—Composition 7s. 6d. in the £, payable June 14th at Official Receiver's offices, 35, Victoria Street, Liverpool.

The Electrical Trade.—The annual report of the Wolverhampton Incorporated Chamber of Commerce, issued last week, contains the following reference to the electrical engineering trade:—

"The application of electricity for power, traction and lighting, continues to make considerable headway. Many important installations have been put into successful operation during the year, and not the least important has been the electrification of the Hammersmith to City line of the Great Western Railway Co., a large portion of the machinery for which was made in Wolverhampton. There has been a good demand for all kinds of electrical machinery from South Africa, Australia, New Zealand, and South America, and during the past few months a number of very valuable inquiries have been received from Canada, from which a good deal of business will, in all probability, result. The total demand, however, still falls short of the enormous manufacturing capacity in this country, and, consequently, low prices prevail. Notwithstanding dear metals, particularly copper, which forms so large a factor in electrical manufactures, prices of the finished product have continued to fall. There is a feeling that bottom has now been reached, and it is thought that if manufacturers would only be contented with rather fewer orders, and asked better prices all round, the present condition of things would be greatly improved. The local factories have been well supplied with orders, but complain of unattractive prices."

Catalogues and Lists.—From MESSRS. W. T. GLOVER AND CO., LTD., of Trafford Park, we have received one of their now well-known almanacs. As it was announced some time ago would be the case, the present issue covers the period from July 1st, 1907, to June 30th, 1908. Its daily slips will, as usual, be perused with interest and profit by large numbers of customers and friends of the firm, and in its new form the almanac can be more accessibly placed for reference than could previous issues. With the block is also sent a file for holding those sheets which the user finds of special interest. The selections, which vary from grave to gay, include extracts from Institution papers and discussions from articles in the technical Press, useful technical data, interspersed with occasional small photo-process prints of Glover manufactures and a number of humorous cartoons, with a little religious counsel and comment sandwiched between for Sunday consideration.

RAWORTH'S TRACTION PATENTS, LTD., 2, Queen Anne's Gate, S.W.—Small pamphlets describing, in simple language, the principles and advantages of regenerative control for tramways and railways.

TARMACISER, LTD., 7, Victoria Street, S.W.—Four-page publication giving particulars of Ames' patent "Tarmaciser" for applying tar to macadam roadways.

BRITISH INSULATED AND HELSBY CABLES, LTD., Prescot.—Well produced brochure of 28 pages, containing many photo-process illustrations of large telephone exchanges that have been equipped by the company, on common battery, common battery signalling, and magneto systems, for the British Post Office and the National Telephone Co. London and Birmingham trunk exchanges of the Post Office, and the Newcastle and Glasgow exchanges of the N.T. Co., also Cardiff Post Office exchange, are the subjects of the views.

Mr. E. C. AMOS, 22, Walbrook, London, E.C.—Booklet (32 pages) containing a brief description of the German Niles Tool Works, at Ober-Schoeneweide, near Berlin. A large number of half-tone photo-process illustrations appear of the various departments of the works, drawing offices. The company are manufacturing machine tools on the American principle. Mr. Amos will send copies of sectional catalogue to anyone interested.

MR. F. WOOLNOUGH, St. Stephen's, Norwich.—New eight-page pamphlet illustrating and giving particulars of his continuous current motors up to 30 B.H.P., also prices of same.

THE VALOR CO., LTD, Rocky Lane, Aston Cross, Birmingham.—Leaflet relating to the "New Era" steel fire extinguishers for motor-omnibus, warehouse and other protection.

MESSRS CUTTING BROS., LTD., Park Works, Stamford.—Illustrated card with specification of D-type electric motors; also one relating to electric hoists and stating prices of same.

MESSRS. BOULTON & PAUL, LTD., Norwich.—Illustrated card relating to their frictionless non-chokable diaphragm pump.

Book Notices.—*Transformatoren und Asynchronmotoren.* By W. Winkelmann. Vol. 5 of *Repetitorien der Elektrotechnik.* Hanover: Dr. Max Jänecke. Price 4 M. 20 pf.—The writer of this book has attempted to give an outline of the principles underlying the design of induction apparatus suitable for students and young engineers. An elementary knowledge of alternating currents is assumed, and frequent references to Kapp, Arnold, &c., also occur, so that practically all the space is available for dealing with the special characteristics of transformers and induction motors. The information given, however, is by no means complete. Isolated points are dealt with in undue detail, *e.g.*, the calculations of the magnetic leakage in transformers, whilst essential points like the numerical determination of the voltage drop in transformers and the heating question are inadequately treated. The latter half of the book, dealing with induction motors, is wholly confined to three-phase machines, and these are only treated from the electrical point of view, the mechanical construction not being touched upon. Useful chapters are the one explaining the construction and use of the Heyland diagram and the one giving complete details of the design of a three-phase 5-H.P. induction motor. Several printer's errors require correction. Thus, on p. 42, $\frac{m_1}{2}\ \delta_1$ is put in place of $\frac{m_1}{2}\ \frac{x}{\delta_1}$; on p. 50, 1·07 × ·0018 occurs for 1·17 × ·0018; on p. 94 the torque given as 4·05 mkg. should be 2·55 mkg.; whilst on pp. 95 and 96, the arrangement of the curves near the origin is incorrect and misleading.

Die Kohlenglühfäden für Elektrische Glühlampen. By Heinrich Weber. Hanover: Dr. Max Jänecke. Price 5 M. 60 pf.—The subject of the preparation, testing and calculation of carbon filaments (as distinguished from the more general subject of incandescent lamp manufacture) is treated in much detail, and from the specialist's point of view, in this little book. The result is a comprehensive and up-to-date account of an important branch of electrical work which has hardly received adequate discussion hitherto. It is true that carbon lamps are likely to be largely replaced in the near future by one form or another of the metal filament lamps; but a discussion such as this of the difficulties met with in the one case may easily prove of value to makers of the newer lamps. The book is divided into chapters dealing with: The development of the manufacture of filaments; The methods employed at the present time; The squirting of solid and hollow filaments; Washing, collecting and drying the filaments; Cutting off and measuring; Flashing; and The calculation of the dimensions of solid and hollow filaments. The illustrations of processes and apparatus are numerous and clear.

"Drahtlose Telephonie." By Ernst Ruhmer. Berlin: The Author. 1907.

"The Technical Index," Vol. 10, No. 3. Brussels: M. J. Fitzpatrick. June, 1907.

"Exercices et Projets d'Electro-technique." By Eric Gerard and Omer de Bast. Paris: Gauthier-Villars. 1907.

Bath and West Show.—At this show Messrs. Crossley had an exhibit showing their gas and oil engines in motion. In order to obtain the necessary load for the engine they had coupled up various fittings lent by the Cardiff depôt of the Edison & Swan United Electric Light Co., Ltd., a pair of "Ediswan Carbone" new flame arcs were connected to the temporary wiring.

Trade Announcements.—The Yorkshire Machine Tool and Engineering Works will in future be known as the Alma Machine Tool and Engineering Works, Liversedge (England). The company have for some time past been bringing their manufacturing equipment up to the recognised modern standard, and have recently availed themselves of the services of Mr. T. W. Webb, M.I.M.E., an expert in up-to-date machine tool practice, as general manager. Mr. Webb has resigned an important position in the management of the Birmingham Small Arms Works to take up the appointment at Liversedge.

Mr. J. P. Child, 16, Baxter Avenue, Doncaster, has taken over the whole of the connection of the Northern Electrical Co. at Doncaster, the company having discontinued the branch. Mr. Child has acted as the company's manager at Doncaster,

The registered office of the British Aluminium Co., Ltd., was on June 10th removed to 109, Queen Victoria Street, London, E.C. The telephone number is 4,315 London Wall.

The Societe Belge pour la Fabrication des Cables and Fils Electriques, of 37 rue St. Lazare, Brussels, has acquired the works, &c., of la Société Anonyme des Usines Hen, rue Stephenson, 10, Schaerbeek. The company has sent us a copy of its price list of vulcanised rubber insulated wires and cables.

Mr. F. T. Hanks, of 1, Higham Place, Newcastle-on-Tyne (telephone: "Central 3,069"), has been appointed by Messrs. Evershed & Vignoles, Ltd., of Acton Lane Works, Chiswick, London, W., their agent for Newcastle and district. Mr. Hanks has been for many years connected with Messrs. J. H. Holmes & Co., and has an extensive connection in the neighbourhood. Messrs. Evershed and Vignoles, Ltd., request that all inquiries and orders from the Newcastle-on-Tyne district for their manufactures, which include Meggers and bridge Meggers, moving coil and other switchboard instruments, Murday recording ammeters and voltmeters, &c., should be sent to Mr. Hanks.

The Berry Construction Co., Ltd., has changed its address to Charing Cross House, Charing Cross Road, London, W.C.

LIGHTING and POWER NOTES.

Aston.—The T.C. has applied for a loan of £17,519 for the Erdington E.L. scheme.

Barnsley.—A loan of £2,000 for extension of mains and additions to plant has been applied for by the T.C.

Brandon.—The U.D.C. has sealed an agreement with the North Brancepeth Coal Co., Ltd., for the supply of electricity at Littleburn.

Carnarvon.—The T.C. has retained Mr. Price White as consulting engineer for its electrical work.

Continental Notes.—Spain.—A company has lately been formed in Leon, with a capital of £40,000 and the title La Sociedad Leon Industrial Electricidad y Agnas, to put down a plant to utilise the water-power of the River Porma near that town, in the generation of electrical energy for lighting and power purposes.

Croydon.—The electrical undertaking shows a profit during the past year, after meeting interest and sinking fund, of £8,927, there being, after bringing in balances from the previous year and transferring £3,000 to reserve, a final balance of £10,248.

Darlington.—The T.C. has refused permission for the Cleveland and Durham County Electric Power Co. to supply power to Albert Hill Wire Mills, as the Council maintains that it is supplying power at a reasonable rate.

Devonport.—The T.C. has reduced the price of electricity for lighting to 4d. per unit, and for power, heating and cooking to 1·75d. per unit between 11 p.m. and 4 p.m. in January, February, October, November and December, and between 11 p.m. and 7 p.m. in the other months of the year.

A loan of £2,000 for installing motors on the hire system has been applied for.

Dundee.—The accounts of the electricity department for the year ending April 30th, 1907, show that the total number of units sold amounted to 4,008,413, with a revenue of £31,803, compared with 3,439,231 units and £30,923 respectively in the previous year. The reduction which was made on the charge for private lighting from 4d. to 3½d., and on the tramway supply from 1½d. to 1¼d. per unit is responsible for the slight increase in revenue compared to the increase in units sold. The revenue account shows a credit balance of £17,166 as against £17,140 in the previous year. With this surplus the committee has decided to further reduce the capital debt of the undertaking, and this year has transferred the sum of £6,736 from the capital account to revenue. After payment of interest and sinking fund charges amounting to £9,782, the net surplus amounts to £914. During the last three years the sum of £18,000 has been paid out of revenue, fully half of which was for the big alterations at the power station, while the balance has been transferred from the capital account.

Eastbourne.—A L.G.B. inquiry was held last week into the application of the T.C. for a loan of £9,934 for the extension of the plant at the electricity works, and also for a loan of £3,112 for the purchase of four motor-buses. There was no opposition.

Highbridge.—The promoters of the E.L. scheme have written to the U.D.C. informing that body that "on account of the Council having endeavoured to baulk them in every way with respect to their efforts to supply the district with E.L., they had resolved to abandon the whole scheme."

Hull.—The revenue of the electrical undertaking for the year ending March 31st last, amounted to £45,433; expenses were £22,541, and after meeting financial and special charges, there remained a balance of £1,813, which was allocated to renewals and reserve. A total of 4,419,673 units was supplied during the year, 2,338,731 being for power purposes.

Lincoln.—The year's working of the E.L. undertaking resulted in a gross revenue of £11,647, as compared with £8,695 in the preceding year. After meeting working expenses (·993d. per unit) and financial charges (·635d. per unit), a surplus of £3,083 remains. The units sold include private lighting, 404,310; public lighting, 65,460; general power supply, 79,983; to Messrs. Clayton and Shuttleworth, 568,359; and for traction, 164,314; a total of 1,282,426 units.

London.—L.C.C. Electric Supply Bill.—The proceedings at Tuesday's meeting of the L.C.C. show that the present majority control is beginning to redeem its election pledges and respond to the mandate given to it by the electorate last March. Notwithstanding the strenuous opposition of the municipal trading element, which secured 39 votes in favour of an amendment to the first of a series of resolutions as compared with 79 votes against it, the Council agreed to the proposals put forward by the Parliamentary Committee in regard to the Council's Electric Supply Bill. It was, for instance, decided to delete from the Bill the clauses providing for the compulsory acquisition of the undertakings of the Borough Councils, and for the transfer to the County Council of the powers of purchase possessed by local authorities throughout the area of supply proposed in the Bill in regard to undertakings in their several districts. The second resolution

reduced the projected expenditure embodied in the Bill from £4,500,000 to £100,000; and the third deleted the special powers sought in regard to the breaking up of the streets, and incorporated the general law on the subject in so far as it is applicable, together with a clause dealing with routes to be followed in laying electric lines. It was also decided to omit the powers sought to enable the generating stations and other works comprised in the tramway undertaking to be appropriated as part of the proposed undertaking, but to seek power to enable the Council to supply surplus energy from the Greenwich station for the purpose of the contemplated undertaking, and to permit the use of the Council's tramway ducts for purposes of the scheme. The Council also resolved to make provision in the Bill to the effect that any assignment or transfer should be subject to the following conditions:—(1) The undertaking to be purchasable by the Council at the end of a period not exceeding 50 years on the terms of the Electric Lighting Act, 1888, or on such other terms as may be specified in the deed of assignment and approved by the Board of Trade; (2) the amount of dividend which may be divided by the transferees to be regulated by the prices charged by them for electrical energy on a basis to be approved by the Board of Trade; (3) the maximum prices to be charged by the transferees not to exceed those prescribed by the Bill, and such maximum prices and the relation between price and dividend to be subject to periodical revision; (4) facilities to be granted to the Council at any time to examine accounts and works of the proposed undertaking, and the assignment to contain such other provisions as may be deemed necessary for securing adequate control by the Council with regard to the powers transferred or assigned. The final resolutions decided that the Bill should provide for the cesser of the Council's powers thereunder, unless a transfer or assignment had been made within a period of one year from the passing of the intended Act, and that the Parliamentary Committee should be authorised to give effect to the foregoing decisions.

MARYLEBONE.—The electrical sub-station of the B.C. in North Street, Marylebone, took fire at noon on Saturday last, and was considerably damaged.

SOUTHWARK.—The electrical engineer has advised the Electric Lighting Committee to install an electrically-driven feed pump, costing some £300, at the generating station; the Committee has accepted the offer of the County of London Electric Supply Co. for the lighting of the clock tower now being erected in St. George's Circus.

Llansamlet.—An E.L. scheme has been presented to the U.D.C. by Mr. J. W. Johnston, the proposal including the erection of a dam and turbine-driven generator, at the Glanbraw Brook. The scheme is under consideration.

Northallerton.—The U.D.C. has accepted the tender of the E.L. Co. for public lighting for two years. The Council has decided to ask the E.L. Co. if it is in a position to dispose of the undertaking, and upon what terms.

Nottingham.—The annual report states that the total H.P. installed at the three generating stations is as follows, viz.:—Talbot Street station, 8,925 H.P.; St. Ann's power station, 6,040 H.P.; Eastcroft, 720 H.P.; making a total of 15,685 H.P. The distributing mains have a total mileage of 54·26. The number of applications for a supply of electricity at March 31st, 1907, was 3,257, as compared with 3,040 at March 31st, 1906, an increase of 217. The number of 8-C.P. lamps, or their equivalent, has increased from 297,553 to 321,240 during the same period. Eighty-nine additional motors, representing 671 H.P., have been connected to the mains during the year. The totals at March 31st being 742 motors, equal to 2,934 H.P. The number of units sold during the year for various purposes was as follows:—For lighting, 3,881,267; for power, 1,332,174; for traction, 4,316,655; total, 9,530,096; an increase of 477,534 units; 48·16 per cent. of the units sold for private lighting were at the reduced rate of 1½d. per unit. The increase in the maximum load was not so large as anticipated last year, mainly owing to the great number of Tantalum lamps that have been installed, especially in business premises.

Oldham.—The T.C. has adopted an alternative charge of 4d. per unit for electricity consumed between 6 p.m. and 10 p.m., and 1½d. per unit at other times on the two-rate meter system.

Shanklin.—The U.D.C. has extended the public lighting contract with the Isle of Wight E.L. Co. for two years from December 31st, 1907.

Sheffield.—In a report by Mr. S. E. Fedden, the general manager, on the progress of the electrical undertaking during the past year, it is pointed out that there has been a continuous increase in the consumption of electrical energy for light, power and heat. The increase in the consumption of electrical energy for motive power was greater in proportion than the increase in the number of consumers, due to the gradual conversion of large works to electric driving, which was continually in progress. Many new connections were traceable to the recommendations of users, and the department's continuous canvassing, supplemented by the excellent advertising effect of the recent Electrical Exhibition, was producing very satisfactory results among the local industries. In considering the financial result of the year's working, the surplus of £2,555 should be increased by the amount of £1,375 deficit on the previous year's balance-sheet, making an advance on the last year's working of £3,930. The capital expenditure to March 25th, 1906, amounted to £839,036, and the expenditure for the year to £21,206. The total income from all sources amounted to £69,469, and the total cost of generation, distribution, rates and taxes, and the management to £19,586. Interest and sinking fund required £47,328, leaving a net surplus for the year, after covering all charges, of £2,555. The accumulated surplus at March 25th, 1906, was £18,977 and as £5,000 had been transferred to the renewal fund, there was now a total available surplus of £16,532. The total number of units sold was 6,778,555; in spite, too, of the increased price of coal, the cost per unit was decreased by ·08d., due to the more efficient working of the Neepsend station.

Southampton.—The Electricity Committee has recommended the T.C. to apply for a loan of £3,000 for mains and services. The same Committee does not recommend the purchase of the Southern Electric Free Wiring Co.'s interests in the free wire undertaking, but suggests that the agreement between the Council and the company be terminated six months hence.

Stafford.—The revenue from sale of energy and public lighting at the Corporation electricity works last year amounted to £3,971, against £4,134 in the previous year. This decrease left the profit at £2,445, as compared with £2,551. With the profit of last year, the Committee brought forward a debit balance of £1,485, which it has wiped off, and has also paid the interest and instalment on loans. The Committee asks the Council to continue the contribution of £1,115 from the rates, this sum being equal to the loans repaid.

Stretford.—A dispute has arisen with the Manchester Corporation with regard to the price to be charged for current for lighting and traction purposes at the Chorlton Road tramways depôt and junctions. Stretford asks for 1½d. per unit, which Manchester declines to pay.

Sunderland.—The past year's working of the electricity undertaking has resulted in a deficit of £690. This result was foreseen in the estimates, owing to the large reduction in price made last year to all classes of consumers.

Tunbridge Wells.—The T.C. has decided to apply for a loan of £9,600 for electricity purposes, made up as under:—500-KW. steam turbo-alternator, condensing plant, &c., £4,850; boiler, superheater, &c., £1,203; public lamps, £900; contingencies, £707; expenditure on capital account in anticipation of sanction, £1,940.

Wednesbury.—The T.C. has definitely decided to install its own gas-driven generating plant, in place of taking a supply in bulk from the Midland Electric Corporation; the cost, £7,860, is covered by a loan of £8,000, which the Council is applying for.

TRAMWAY and RAILWAY NOTES.

Belfast.—At the monthly meeting of the Tramways and Electrical Committee on the 10th inst., Sir Robert Anderson presiding, a deputation from the Donegall Road suburb was heard in connection with the movement for an extension of the tramway system in that locality. The Committee promised to give the matter every consideration. Subsequently the manager, Mr. Nance, was instructed to furnish a general report on the extensions which were before the Corporation at the time of the purchase, and not included in the Act. There are agitations for extensions in three suburbs of the city.

Colchester.—There is a deficiency on the tramways undertaking for the year of £2,089, which has had to be made up from the rates. Shorter stages at lower fares are held to be responsible for the diminished receipts.

Continental Notes.—SPAIN.—The work of converting the tramways in the town of Carthagena to electric traction has now been completed, and the new system is expected to be put in operation next week.

Croydon.—The report of the tramways manager covering the period of ten months ended March 31st, came before the B.C. recently, with a recommendation of the Tramways Committee that the surplus of £9,053 should be carried to a reserve and renewals fund. The Council commenced working the tramways for itself on June 1st, 1906, and the financial results were returned as follows:—Traffic receipts, £61,091; other receipts, £975; working expenses, £41,772; with bank interest added, this left a balance of £20,696, from which was deducted £6,238 interest, and £4,804 sinking fund, &c., leaving the net available balance stated. The average fare per mile was ·52d., as compared with ·66d. in 30 of the largest towns in the country. For energy, at 2d. per unit, £12,596 was paid to the electricity department of the Council. The average traffic revenue per car-mile was 9·76d., and the profit per passenger ·34d. Alderman J. Trumble, who moved the report, said that had the tramways continued under B.E.T. control, the net balance in favour of the Council on the ten months' working would have been £2,159, instead of £9,053. However, it was only fair to say that had the Council accepted the B.E.T. Co.'s second offer for a renewed lease, under which it was promised 7 per cent. on capital expenditure, and 25 per cent. of the profits, it would have received £3,699 net on the ten months' working.

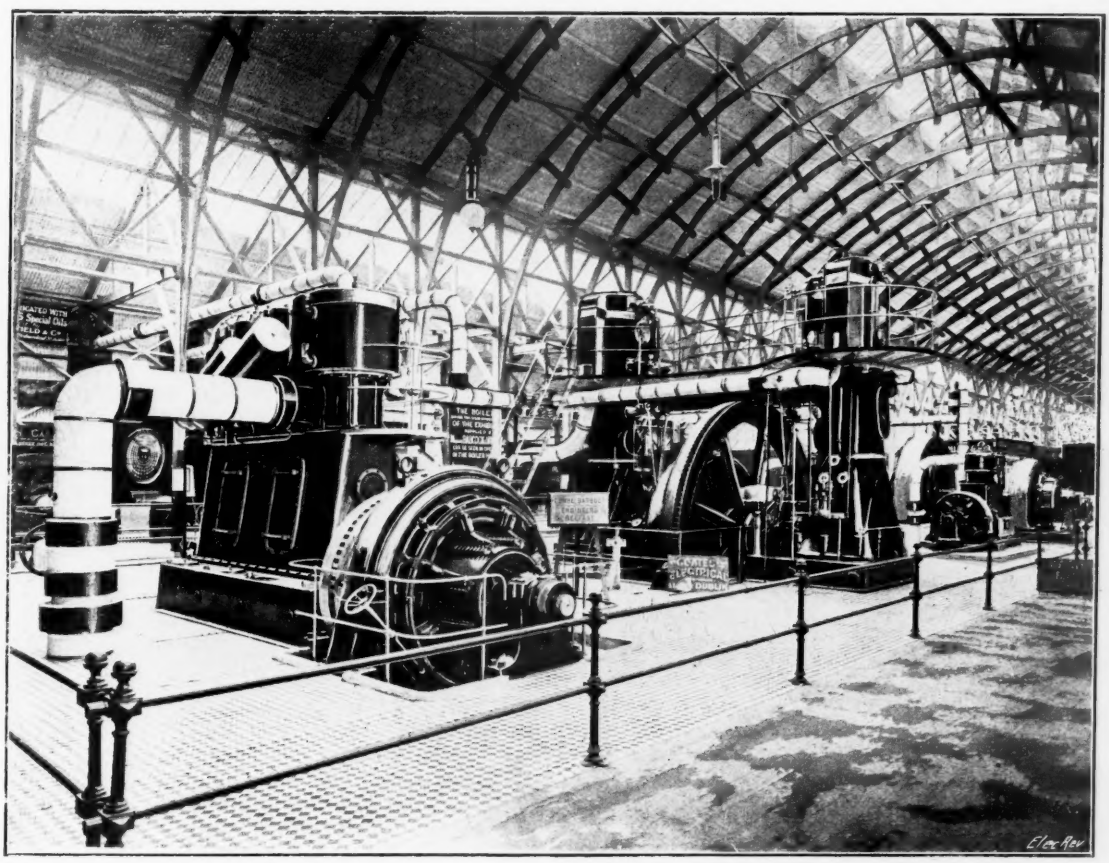
(*Continued on page* 971.)

THE IRISH INTERNATIONAL EXHIBITION.

Ireland's greatest exhibition was opened on May 4th, and it was observed on all hands that never before in the history of exhibitions had one been so far advanced upon the opening day. True, the French Pavilion is yet but an exterior, and that the Home Industries Section was formally inaugurated on June 1st. The former is relatively unimportant, and its tardy beginning was due to some differences between the Government of France and the Exhibition authorities, while the cloth and carpet weavers, the toothbrush and boot makers of the Home Industries have been busily turning out their wares for several weeks.

heard already deriding our puny attempt at an Exposition, and our own Islanders who visited Glasgow in 1901 draw unnecessary comparisons between the machinery hall there and here in Dublin. As a fact there is no Machinery Hall, the Palace of Mechanical Art appropriately taking its place; for Ireland is not and will not be, at least for centuries, a country of heavy machines, of teeming workshops and factories, in which the nominally picturesque poverty of the land-holding peasant is exchanged for the all-too-frequent squalid misery of the manufacturing town.

So it comes about that our interest is centred in, if not



View of the Electrical Generating Plant, Dublin Exhibition.

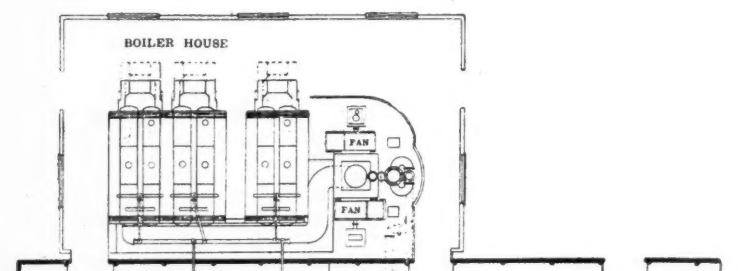
This exhibition does the highest credit to Ireland, and incidentally to the Lord Lieutenant and the indefatigable executive.

It should dispel for ever the impression that the Irish lack energy and initiative, except where a constable or an agent is concerned, for purely Irish firms throughout the provinces have responded admirably to the occasion, both as guarantors and as exhibitors. Good taste, not invariably a characteristic on such occasions, informs the whole. The buildings are varied yet harmonious, immense but not ponderous; the grounds are a delight; and the dressing and arrangement of the stands are in keeping with the general artistic atmosphere.

That type of American of which we have seen so much as almost to be deluded into thinking it *the* type, has been confined entirely to, the power station and the methods of distributing and utilising electrical energy throughout the Exhibition.

It is said that the installation at the Glasgow Exhibition was of so temporary a nature that the engines were restrained from walking into the boiler-house by the steam piping only. However, without drawing comparisons, we may say that the first impression which the visitor gets after entering the power station is one of order, precision, neatness, and finish. When every engine is running there is no vibration, and the various sets have been disposed with admirable forethought, both from the point of view of display and operation. Those last words indicate the gist of the policy which has guided the Executive in all matters connected with the generating plant—effective display combined with efficient operation—

for it was realised that the engines and dynamos would be a great draw, while, under even the most favourable conditions, the cost of erecting, running and dismantling a 2,000-H.P. station within 12 months would be no trifle. The actual cost of the whole plant is a matter of speculation to the onlooker, but we have excellent reasons for knowing that thousands of pounds were saved by the phenomenal exertions of Mr. E. S. Dashwood, who, by squeezing here, lending a hand there, cajoling, exhorting, imploring, and magnetising everywhere, succeeded almost beyond hope in gathering together as sound a lot of machines as is to be found in any electrical supply station in the kingdom.



Plan of the Steam and Electrical Plant, Dublin Exhibition.

Mr. Dashwood's modesty is as extraordinary as his energy, so that his efforts on behalf of the Exhibition have not met before with public acknowledgment, and we are by no means sure that he will be pleased with this well-deserved recognition on our part.

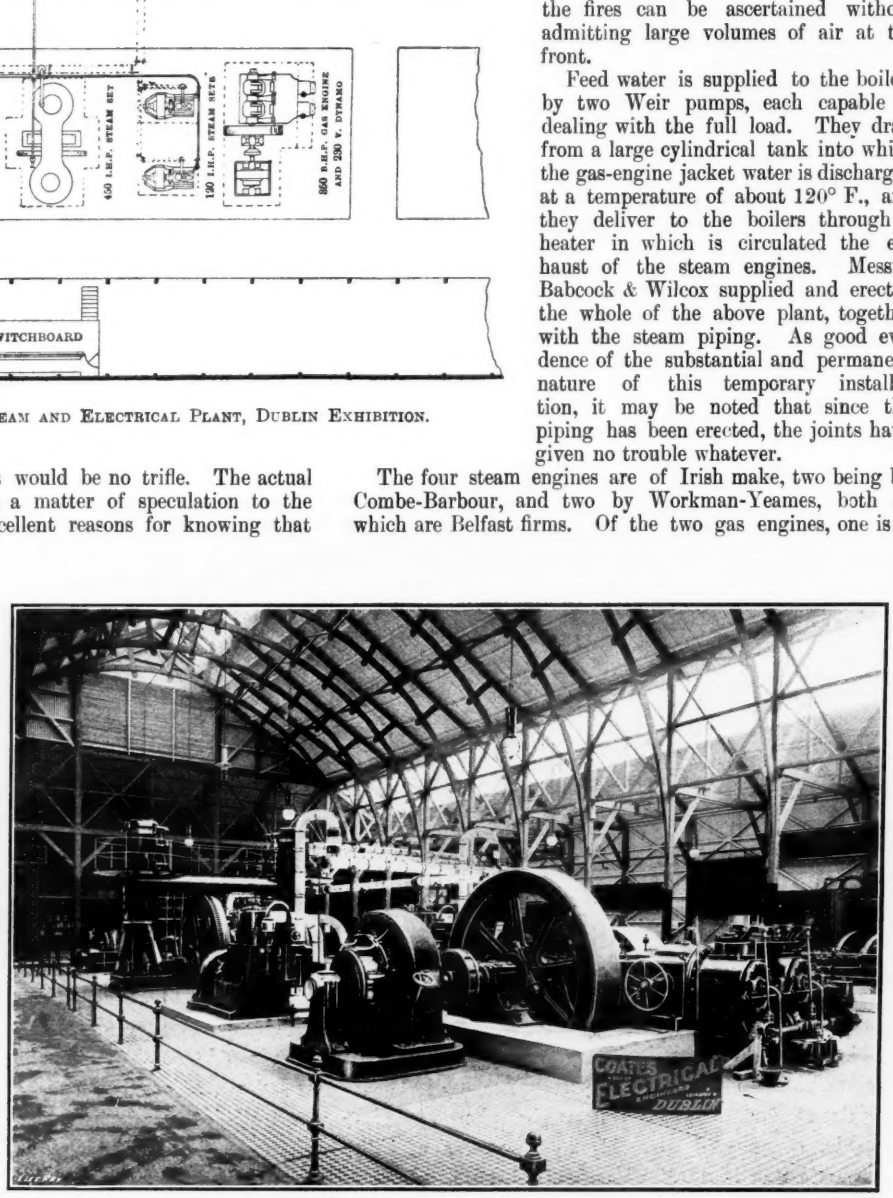
Roughly, the plant is divided into two parts, half being gas and half steam-driven. Steam is raised to 150 lb. per sq. in. with 120° F. superheat, in three of Messrs. Babcock & Wilcox's very latest boilers, which are fitted with chain grates of the close-link pattern, driven at three speeds by means of an entirely enclosed change gear, which runs in oil. A small steam engine drives the countershaft running in front of the boilers, and chains of special design transmit the motion to the grates. Each boiler is rated at 10,000 lb. per hour, and this evaporation is obtained quite comfortably, the necessary draught being obtained by duplicate sets of Musgrave fans, which discharge the flue gases directly into the unlined self-supporting steel chimney, 65 ft. in height by 4 ft. 6 in. diameter. It is a noticeable fact that the kitchens of the Palace Restaurant, on the other side of the Grand Avenue, make more smoke than this range of boilers; indeed, emission of any smoke whatever is of the rarest occurrence.

Convenient sight doors are placed near the back and front of each furnace on both sides, so that the condition of the fires can be ascertained without admitting large volumes of air at the front.

Feed water is supplied to the boilers by two Weir pumps, each capable of dealing with the full load. They draw from a large cylindrical tank into which the gas-engine jacket water is discharged at a temperature of about 120° F., and they deliver to the boilers through a heater in which is circulated the exhaust of the steam engines. Messrs. Babcock & Wilcox supplied and erected the whole of the above plant, together with the steam piping. As good evidence of the substantial and permanent nature of this temporary installation, it may be noted that since the piping has been erected, the joints have given no trouble whatever.

The four steam engines are of Irish make, two being by Combe-Barbour, and two by Workman-Yeames, both of which are Belfast firms. Of the two gas engines, one is a National and the other a Crossley, names which are as well-known in Ireland as across the Channel.

The fundamental idea underlying the power station scheme was to have the units dissimilar, so that the whole



The Exhibition Power Plant; 400-H.P. National Gas Engine and Siemens Generator in the Foreground.

should provide the greatest possible interest to visitors, and whether by good luck or from opportunities of selection, the result has capped the desire, for no two of the engines are alike, yet each is the best of its kind, and all together furnish an admirable opportunity for the buyer and for the constantly growing number of people, from professional to dilettante, who take some degree of interest in mechanical science and its products.

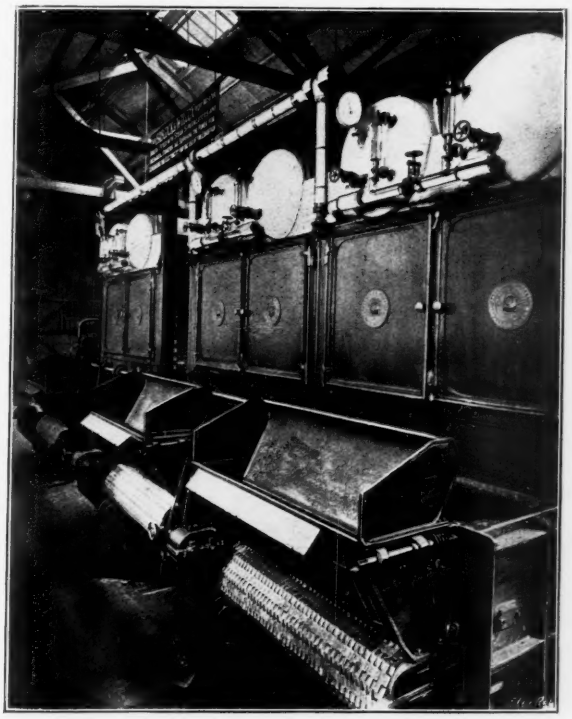
It was hoped that an exhaust turbine would be included, but other considerations rendered this impossible. Undoubtedly the exhibit is incomplete without a turbine of some sort.

Travelling westwards along the hall the first generating-set seen is the high-speed enclosed Combe-Barbour-Westinghouse of 400 KW. at 220 volts. The engine is of the triple expansion type with cylinders 14½ in. × 20½ in. × 31 in., with a 15 in. stroke. It runs at 330 R.P.M., and so sweetly that certain of the less mechanically minded have been heard to describe it to their lady friends as a turbine—turbines being the fashion just now. Both the engine and dynamo have an overload rating of 25 per cent. for 2 hours, and 50 per cent. for short periods. The pistons are fitted with Rowan's rings. The L.P. piston is made of wrought steel, but the H.P. and the intermediate are of cast steel, all being of the same weight. All parts are lubricated under a pressure of 25 to 30 lb. per sq. in. by two valveless pumps, either of which is capable of supplying the engine. The main stop valve is fitted with a nickel seating for use with superheated steam, and the governor is of the spring-loaded pattern acting on the throttle. This governor allows a momentary maximum variation of 2 per cent., while 5 per cent. regulation up or down is obtainable with a hand adjustment.

The engine is remarkably accessible in all its parts, a matter which has received insufficient attention at the hands of certain designers. Large doors in the crank chambers enable the brasses, connecting rods and slides to be removed without breaking joints, and by the simple expedient of inserting screwed plugs in the cylinder covers over the usual lifting bolt holes in the pistons, any or all of the pistons and rods can be lifted and held at any position in the cylinders without removing the covers.

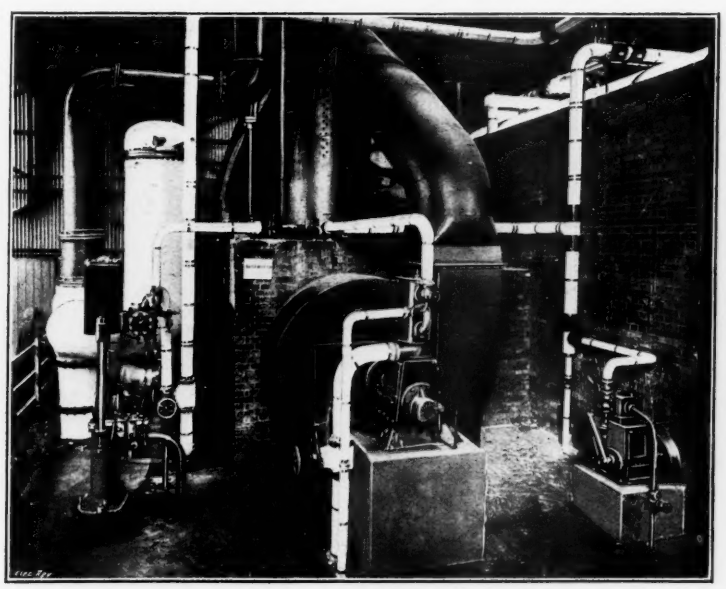
The generator is one of the British Westinghouse Co.'s standard multipolar machines.

The next engine and dynamo are by the same makers as the first, but the engine is of the low speed, vertical cross-compound type, having fly-wheel and dynamo set between the cylinders. It is rated at 450 I.H.P., 300 KW. at 500-550 volts, and is a good example of a low speed traction or mill set. It is used for lighting the thousands of lamps which outline the Central Palace and the Palace of Art. The cylinders and the steam and exhaust passages are all cast separately, as a precaution against unsound metal. Both cylinders have Corliss valves fitted in the covers, an arrangement which has reduced the clearances to 2½ per cent. and 1 per cent. respectively in the H.P. and L.P. cylinders. The



Steam-Raising Plant, Dublin Exhibition.

Combe-Barbour patent trip gear operates the admission valves, and the exhaust valves are worked by wrist plates, which allow them to be practically stationary immediately after closing. The steam and exhaust valve motions are derived from separate eccentrics, and the setting can be altered during running. The L.P. trip gear is adjustable by hand to cut off up to ¾ stroke, and the H.P. gear is similar, but is controlled by the spring-loaded governor, which is driven by a Morse chain from the crank shaft. An automatic knock-out device closes the stop valve when the speed exceeds 10 per cent. over the normal.



View of the Induced-Draught Plant, Feed Pumps, &c.

United States metallic packing is used in all glands of these two Combe-Barbour engines.

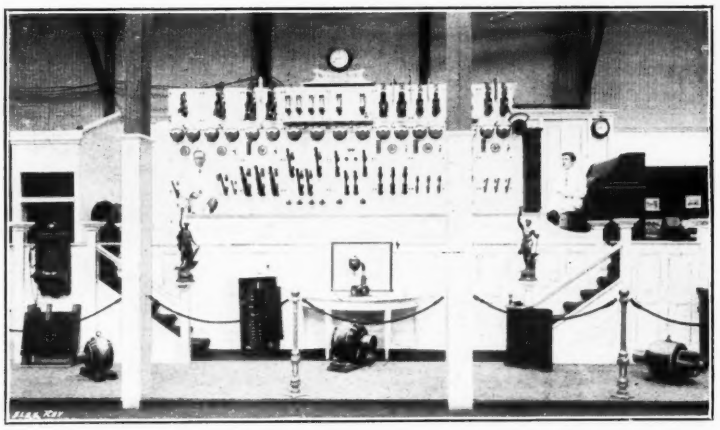
The main bearings of the low-speed engine can be water-jacketed if desired, but the jackets are not used at the Exhibition, the cooling effect of the lubrication derived from a rotary oil pump being sufficient.

The fly-wheel is 15 ft. in diameter, and weighs 18 tons. It is cast in two pieces, and is held to the shaft with shrinking hoops and keys. The chief dimensions of this engine are: Height, 17 ft.; length over bed-plates, 20 ft. 6 in.; width, over fly-wheel hand-rail, 17 ft.; cylinders, 16 in. × 32 in. × 30 in. stroke; speed, 90 R.P.M.

Next come two high-speed enclosed vertical engines of 120 H.P. by the enterprising firm of Workman-Yeames. They are coupled direct to General Electric dynamos, one generating at 460 volts, the other at 230 volts, when running at 500 R.P.M.

The 400-H.P. engine by the National Gas Engine Co. is of an entirely new design, having been built especially to combine simplicity with rigidity. Certainly it has a very

massive appearance, as it lies right across the width of the power station allotment. It has twin horizontal cylinders, and its rigidity is due to the way in which the main frame is built up. The front portion contains the three main bearings, all in one casting, so that absolute alignment is assured, and the second part receives the cylinder castings. A new type of throttle governor, is fitted, which varies the volume of gas and air, the mixture being constant. This produces complete combustion at all loads, and prevents back firing. Two Simms-Bosch magnetos are placed opposite to each other on the combustion chamber cover of each cylinder. Both fire, but only one is necessary. The half-speed shaft is worked from the back of the engine, through bevel wheels gearing into a single side shaft. This arrangement simplifies the engine considerably, and brings all the valves together.



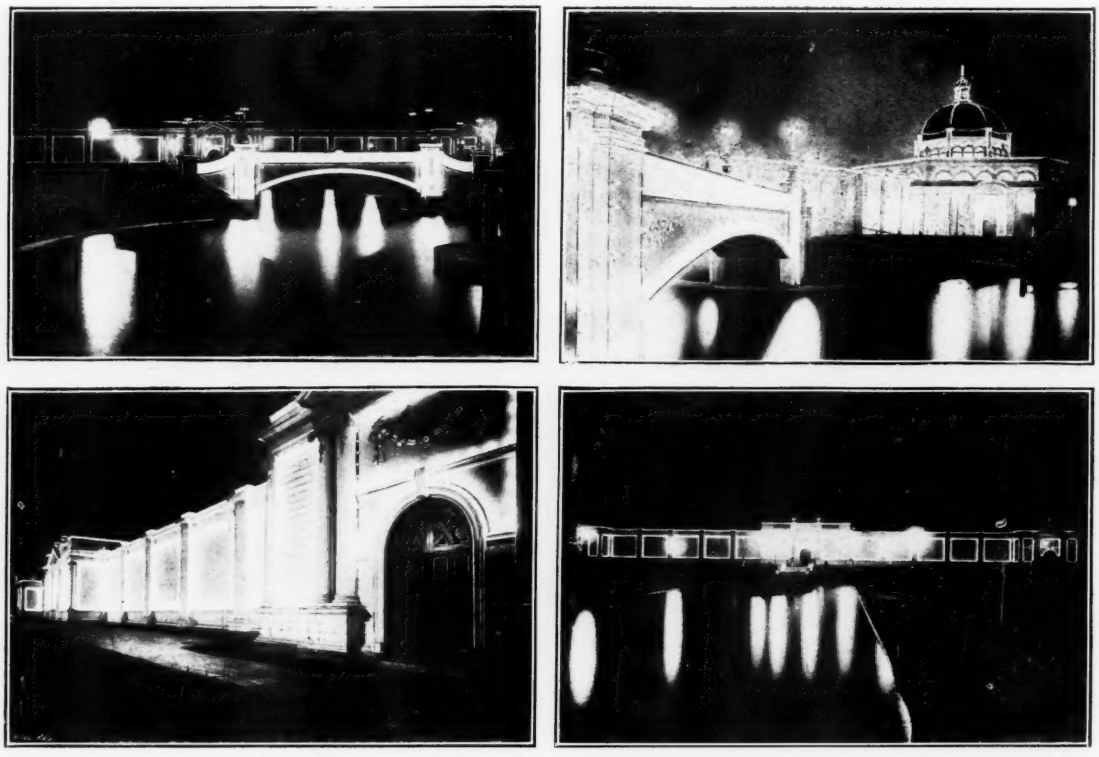
Main Switchboard for the Exhibition Light and Power Circuits.

The Siemens dynamo, generating at 220 volts, is driven by the engine through a flexible belt coupling, which is most suitable for starting, and for alignment when the bed plates of engine and dynamo are not continuous.

The 180-h.p. Crossley engine is of the well-known standard horizontal single-cylinder pattern, driving by belt a G.E.C. 220-volt dynamo. This engine was erected and running long before the Exhibition opened, and was of the greatest service during the time of highest pressure just preceding that event.

The switchboard is a fine specimen of low-pressure work by the General Electric Co., to the requirements of Mr. Dashwood. It is built of Sicilian marble in nine panels, six for the dynamos and three for the main feeders, and is especially arranged with linking switches and a third bus-bar, so that all the 220-230-volt machines can be run upon separate circuits or in parallel with each other, while the 500-volt generator can be thrown on to the 460-volt circuit if anything should prevent the Workman-Yeames set from running. In the ordinary course the separate circuit control is preferred, although there is no difficulty at all in paralleling any of the machines.

The outlining is looked after by the 500-volt Combe-Barbour, the flame arcs are run in 30 circuits of four each, off the 460-volt Workman-Yeames, the Crossley lights the Canadian Pavilion, and so on.



The Exhibition Buildings and Grounds, Electrically Illuminated.

The mains are laid directly in the ground about 12 in. below the surface, and run to distributing switch rooms situated in the Art gallery, the Dome and the main entrance. These cables range from ·95 sq. in. sectional area downwards, and are paper-insulated, lead-covered, made by Henley's. The cables, which feed into sub-distributing centres in other

buildings are of the same type and make, but many miles of Henley's V.I.R. Association cable are in use for interior work. The stands are supplied from below, and the only cables visible either outside or inside the buildings are those feeding the interior arc lamps, and a couple of additional ring mains in the Machinery Hall. The Cantie switch, with quick make-and-break, is used throughout, and all circuits carrying 10 amperes and over are protected by long-break iron-clad fuses of the house-service pattern, porcelain fuses being used for smaller circuits.

With the exception of half the Palace of Mechanical Arts, the Main Entrance, the Gas Pavilion, and the Morehampton Road Avenue, the grounds and buildings are lit by arc lamps; the grounds with 120 Santoni 10-ampere flame arcs run four in series on 220 volts, and the buildings, except under the dome, with 200 5-ampere Davy white arcs of the enclosed type, run two in series on 220 volts; some 200 General Electric open type arcs are also utilised, making 520 arcs in all. The gas lighting is the best of its kind, the Keith, Welsbach and Sugg high-pressure systems vieing with each other, and all with the electric light for the mastery. The best that can be said for the gas lighting is that the avenue or broad walk is brilliantly illuminated, but the general effect of the forest of poles and lanterns must strike the most enamoured gas-man as barbarously ugly, although the blinding glare of bunches of incandescent mantles placed right in the line of sight might draw raptured praises from him. The number of burners per acre must be enormous.

The flame arcs are distributed over the most picturesque portion of the grounds, so that neither by night do myriads of dazzling sources of light irritate the eye, nor by day does a forest of steel poles ruin the prospect. The flame arcs are hung well up over the heads of the people, and the soft effect of diffusion is very pleasant and restful.

Six thousand white and 6,000 ruby lamps pick out the features of the central building, and the change from one colour to the other is made by means of a change-over switch, which was specially designed by the Westinghouse Co. for the purpose. It consists of a pair of large liquid motor starters joined together, the blades being fixed to the same spindle. It is rated to change over full load 120 times an hour without boiling the water.

The whole of the glow lamps in the Exhibition were made by Robertson's.

Some 1,500 lamps burning five in series outline the Art Gallery. This outlining is done chiefly with wood battens, but the more intricate parts of the Dome are wired with Fairyland strip, and this is used for the elaborate decorative and concealed lighting of the Canadian Pavilion. No trouble has been experienced with this form of ready-made wiring, and very little with the more vulnerable batten wiring, which is creditable enough when we mention that the work was done and the lamps in place before the winter was half over. Paraffin wax was used to seal the backs of the holders when in position in the battens, and every holder was dipped in wax before being fastened in. When the time drew near for the opening, all the contact pins were scraped to remove the wax.

Many motors are in use for a variety of purposes. The restaurants are ventilated by Keith-Blackman fans, and a 30-H.P. motor drives one of the induced draught fans in the boiler-house. The Waygood lifts at the water chute were driven by a gas engine until the 30-H.P. Westinghouse motor was found more reliable and no trouble to the attendant. The knives are cleaned and the plates are washed by small independent motors; in the Home Industries Section they weave cloth and carpets and make tooth-brushes and boots; in the Grand Central Hall tiny models of motors drive tiny models of biscuit bakeries and other things; in "Canada" and "New Zealand" large motors drive refrigerating plants, and in other parts of the grounds motors drive pumps (by Gwynne's) for the Rivers of Ireland, pumps for the electric fountain, and pumps (by Fredk. Nell) for the auxiliary fire service. In the Machinery Hall everything is motor-driven—Linotype machines, die presses, printing and lithographing machines of all kinds, sweeteries, bakeries, and conveyors, looms and soap making machines.

There are two extensive systems of telephones, one for the Caterer's Department of 24 lines, and one of 12 lines, which connect the outlying buildings to the exchange in the power station. Ericcson instruments are in use, with inter-communication plug boards by the same makers.

The time of the Exhibition is told by 24 synchronome dials, controlled by a master pendulum of the latest and simplest pattern, in which there is only one wheel left, and that an idle one for all but a fraction of each minute, when the detent is released, which drops the lever, which in dropping gives the required mechanical impulse to the pendulum as the latter is passing through zero. This bell-crank lever then makes a good hard rubbing contact with the hinged armature of an electro-magnet, and at that instant the time control circuit is closed, which permits the battery to send an impulse through the magnet solenoids of every dial. Having accomplished its dual purpose, the lever is thrown back to its stop by the armature on its way to the magnet, and is ready for the next half minute to come round. Meanwhile the pendulum is doing nothing in the way of expending energy except pushing round tooth by tooth an idle wheel.

The system has so may beauties that we are tempted to take up space which cannot be spared.

Messrs. Wm. Coates & Son, Ltd., Belfast and Dublin, were the sole electrical contractors for the Exhibition, as were Messrs. Humphreys for the buildings, and the excellence of their work can be gauged by the statement of the electrical inspector of a fire insurance company that he had never seen so much care taken in an exhibition.

Mr. P. S. Sheardown, M.I.E.E., engineer of the Dublin United Tramways Ltd., in his capacity of hon. consulting engineer to the executive, has contributed not a little to the success of the installation.

Mr. George Marshal Harriss, electrical engineer of Carlow, was in charge of the erection of the machinery, and is acting as resident engineer during the period of the exhibition.

TRAMWAY and RAILWAY NOTES.

(*Continued from page* 966.)

Darlington.—The B. of T. has granted the application of the T.C. for a two years' extension of time for completing the electric tramways to Haughton-le-Skerne.

Lincoln.—Mr. Stanley Clegg, the city electrical engineer and tramways manager, has reported on the working of the Corporation tramways during the past year. It will be recollected that the "G. B." surface contact system is installed at Lincoln, and some interest, therefore, attaches to the returns, which are as follows:—Traffic expenses, 2·51d.; repairs, &c., ·913d.; management, 1·47d.; and power expenses, 1·79d. per car-mile, a total of 6·98d. per car-mile on a mileage of 137,000. The engineer points out that this mileage is the smallest of any municipal system; that a reduction in energy consumption is expected, and that the latter (1·19 units per c.m.) is far less than at Wolverhampton, where the Lorain system is in use. Altogether 1,430,946 passengers were carried, and after meeting financial charges a deficiency of £503 remains on the year's working.

London.—AUDIT OF THE L.C.C. TRAMWAY ACCOUNTS.—After a prolonged discussion on Tuesday, the County Council decided by a majority to approve an estimate of £1,000 in respect of expenses for the preparation of reports on the tramways, steamboats and other departments, and to ask the president of the Institute of Chartered Accountants to report, in conjunction with a member of the Institute, upon these particular accounts. The points to be investigated are (1) the past results and present financial position of the undertakings from a commercial standpoint; (2) the basis upon which the valuation of the tramways was made and referred to last January; (3) the sufficiency of existing renewal funds, the formation of further reserve funds, and the relation of these to the statutory sinking funds; (4) the allocation of expenditure, and particularly the apportionment of the cost of street improvements connected with tramways; and (5) the form of the published balance-sheets and accounts. Access is to be allowed to all books, accounts and documents necessary for the purpose of the investigation and report. As bearing on this question, the report has been issued of Mr. T. Barclay Cockerton, district auditor, on the accounts of the London County Council for

the year ended March 31st, 1906. In referring to the tramways, the auditor states that the total capital expenditure to the close of the year 1905-6 amounted to £4,881,689, of which the sum of £607,230 has been repaid. A sum of £35,000 was transferred during the year to the reserve renewals fund, increasing the latter to £106,684. This sum of £35,000 falls short by about £15,685 of a sum calculated on the basis of 1d. per car-mile. The auditor is of opinion that the Council should be guided entirely by expert advice in fixing the sum to be set aside annually for this purpose, but in considering the matter generally it must always be clearly borne in mind that it is only in respect of those assets whose estimated working life is shorter than the loan period that it becomes strictly necessary to charge any further sum annually against revenue *in addition* to the instalments of the sinking fund. He adds, however, that the amount for renewals referred to above should be regarded as the minimum, and the Council may consider it desirable under certain circumstances to increase the annual additions to this fund. With regard to the cost of street widenings charged to tramways account, the auditor states that, by a clause inserted in each of the London County Council Tramways and Improvements Acts, the Council may apportion the costs and expenses in such manner as it may think proper between the improvements account and any separate account which it may keep in relation to tramways. It is clear, therefore, that he is precluded from any interference with the discretion of the Council in this matter. He alluded in his last report to the fact that several committees of the Council had under their consideration the matter of the incidence of the cost of street widenings in connection with tramway schemes, but no decision was arrived at by the Council till November 20th, 1906. Consequently, the charges under this heading during the year 1905-6 were apportioned in the same manner as criticised in his report. The whole question of these apportionments is one of extreme complexity, and it would be absolutely impossible for him to give any decision on these matters, even if he had legal authority to do so, without holding a local inquiry in each case, assisted by qualified assessors and taking expert evidence on the points at issue. A remedy for the difficulties arising in connection with these apportionments might be found in the insertion of a clause in the Council's Tramways and Improvements Acts, fixing the proportion of expenditure chargeable to the different accounts, or as an alternative the clause might provide for the constitution of an independent tribunal, *e.g.*, the Board of Trade, which would be clothed with full powers to adjudicate on these questions. In conclusion, the auditor draws attention to the various principles adopted by public authorities owning tramways in dealing with the allocation of expenditure incurred in the widening of thoroughfares necessitated by the construction of tramways. For example, in Glasgow, Leeds and Liverpool no part of such expenditure is charged to tramways account, whereas in Middlesex, where it may be noted that the conditions in some cases would appear to approximate closely to the Council's lines, the cost of the widenings is made part of the capital charges of the undertakings, and no part of the cost is charged to the General County rate.

Revision of Fares.—It is understood that as a result of conferences between the managements of the various tube and underground railways, a general revision of fares will be undertaken, resulting possibly in an all-round increase. It is further suggested that the motor-bus companies may come into line with the railways, with a view to avoiding competition and improving the earnings all round.

Manchester.—At a meeting of the Tramways Committee on June 11th, a review of the past year's work was presented. During the year ten additional miles of single track were opened. The aggregate length, including the lines over which the Corporation has running powers, now being worked, is 169½ miles. The passengers carried numbered 143,264,501, against 133,923,932 in the previous year; and the car-mileage was 15,523,549, against 14,655,908 in the previous year. It is estimated that the tramways serve a population of 800,000. The department paid £55,000 in aid of the city rates, placed £87,827 to reserve, renewal and depreciation account, and spent £4,211 on interest account in connection with improvements and street widenings near Piccadilly. Of the passengers carried during the year 99,195,126, or 69·24 per cent., used the 1d. stage; 16,999,980, or 11·86 per cent., the 1½d. stage; and 10,183,362, or 7·11 per cent., the 2d. stage. The percentage of working expenses to receipts was 63·18, and the average total revenue per car mile was 11·12d. The average number of journeys per head of the population per annum was 179. The service in conjunction with the Oldham Corporation began in January, the running powers agreed to establishing a through route between Piccadilly and Waterhead, a distance of nine miles. Similar arrangements have been made with the Ashton-under-Lyne Corporation, making a complete service. In 1905-6 the total revenue of the department was £663,707; last year it reached £719,673. The working expenses, however, have also increased with the extensions of line, amounting to £454,692, against £433,561 in the previous year. The balance of gross profit was £264,980, an increase of over £34,000 on the year 1905-6.

Renfrew. — The County Council has petitioned the Scottish Secretary against the proposed extension of the Paisley District Tramway Co.'s system from Barrhead to Thornliebank, on the ground that there is no demand for the line.

St. Helens.—The B. of T. has deputed Colonel von Donop to inspect the St. Helens tramways and report on the same.

TELEGRAPH and TELEPHONE NOTES.

Japanese Telegraphs.—The Japanese Administration officially announces the opening of telegraph offices at Kushunkotan, Urakimiqofuka and Maukadans in Japanese Sakalien.

Telephone Rates.—The inquiry which the Canadian Railway Commission is conducting into the affairs of certain telephone companies (subsidiary to the Bell Telephone Co.) has evoked evidence to the effect that the estimated cost of installing a mile of wire and apparatus for six services is $781·28. The rates charged in various American cities of about the same population as Montreal (300,000) are as follows (quoted by the *Montreal Star*):—Pittsburg—Bell rate, business, $125; residence, $100; Independent Co. rate, business, $72; residence, $58. Cleveland—Bell, business, $84; residence, $60; Independent, business, $72; residence, $48. St. Louis—Bell, business, $150; residence, $60; Independent, business, $72; residence, $48. Baltimore—Bell, business, measured service; residence, $60; Independent, business, $72; residence, $60. Cincinnati—Bell, business, $100; residence, $48; no independent company. In Montreal the maximum rates charged are:—Business, $55; residence, $35.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Cayenne-Pinheiro	Aug. 18, 1902 ..	..
Curacao-Coro, Curacao-La Guayra, Curacao-Maracaibo } Closed..	Jan. 12, 1906 ..	..
Reissa-Issa and Reissa-Yemani (Yemen) ..	Oct. 22, 1902 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Garachico-Santa Cruz	July 12, 1906 ..	..
Las Palmas-Arecife	Aug. 18, 1906 ..	..
Landlines.		
Puerto-Barrios	Aug. 2 , 1902 ..	..

CONTRACTORS' COLUMN.

Openings for new Business.

ABERGAVENNY.—New wards at Monmouthshire Asylum. E. A. Johnson architect, Abergavenny.

ATHENRY (Ireland).—Agricultural college electrically lighted (£27,000).

ASHTON-UNDER-LYNE.—Extensions to Rock Mill contemplated.

BATLEY (Yorks).—Extension of hospital and E.L. installation. S. Derwen Jones, Electricity Works, Batley.

BEDLINGTON (Northumberland).—New public schools (£2,465). F. & W Simpson, builders, Blyth.

BELFAST.—New theatre, Station Street. C. A. Aikin, architect, Rosemary Street, Belfast.

BIRKDALE.—New Liberal club, Liverpool Road. A. Schofield, architect, Weld Road, Birkdale.

BIRMINGHAM.—Reconstruction of Grand Theatre (£10,000). Frank Matcham, architect, 9, Warwick Court, London.

BOLTON.—New Council schools and extensions to existing ones. F. Wilkinson, Director of Education, Nelson Square, Bolton.

Important additions, Columbia Mills. Wolfenden & Sons, Bolton.

BRADFORD (Little Horton).—Co-operative stores and 13 houses. J. Drake and Son, architects, Queensbury, Yorks.

BRIGHTON.—High school to be rebuilt and extended (£13,500). Girls' Public Day School Trust, Ltd.

BRISTOL (Bedminster).—New public schools. H. Williams, architect, Alliance Chambers, Corn Street, Bristol.

BURSLEM (Haywood).—Additions to hospital (£2,495). J. H. Broadhurst and Son, builders, Burslem.

CHEAM (Surrey).—Baptist church. A. D. Cox, Worcester Park, Surrey, builder; W. Hayne, Frinton-on-Sea, Essex, architect.

CHORLEY (Eccleston).—New cotton mill. Eccleston Manufacturing Co., Ltd., owners.

COLNE (Lancashire).—New weaving shed to contain 500 looms. Proprietor, Mr. George Duckworth.

CRICKLEWOOD.—Five shops in Broadway. Done, Hunter & Co., High Road, Cricklewood, agents.

CROYDON.—Extension of workhouse buildings (£20,000). Berney & Co., George Street, Croydon, architects.

DONCASTER.—Hotel and stables for Carter's Knottingley Brewery Co., Moorthorpe, South Elmsall. Garside & Pennington, architects, Pontefract and Castleford.

DUNDEE (Broughty Ferry).—New post office (£2,500). W. T. Oldrieve, H.M. Office of Works, Parliament Square, Edinburgh, architect.

ELTHAM.—Electric light to be installed in Congregational Church (estimated cost £350).

EXETER.—New public school (E.L. installation). J. Jerman, architect, 1, Bedford Circus, Exeter.

FARNWORTH (Bolton).—Public offices to be erected by the U.D.C. (£12,000).

FRESHFIELD (Near Formby, Lancs.).—Convalescent home. Architect, C. J. Weld-Blundell, Blundell House, Campden Hill, Kensington, W.

GODALMING.—Police court and council chamber (£3,722). Cook & Sons, builders, Crawley.

GOLBORNE (South Lancs.).—New elementary school. H. Littler, county architect, Preston.

GRAVESEND.—New post office buildings. Postmaster, Gravesend.

HALESOWEN.—New colliery, Coomb's Wood. Hingley & Sons, owners.

HAMILTON.—Public baths, washhouses, &c. (£9,000). Burgh Surveyor, Hamilton.

HARLESDEN.—Sunday school in connection with Christ Church, St. Alban's Road.

HOVE.—Free library (£10,000). P. Robinson & Walban Jones, architects, Leeds. F. G. Minter, builder, Ferry Works, High Street, Putney.

HECKMONDWIKE.—Warehouses. S. Sinkinson, architect, Liversedge.
HELENSBURGH.—Masonic Temple in Princes Street. J. W. and J. Laird, architects, 163, Hope Street, Glasgow.
KIRKCALDY.—Proposed new church for Free Church. Rev. A. Gilfillan.
New Templar Hall in Carlyle Road.
LEEDS.—Jewish Synagogue and House of Study (£6,000). Chadwick and Watson, architects, Leeds.
LEEK (Staffs.).—Congregational Day Schools. R. Longden, architect, Burslem and Leek.
LEIGH.—Additions and alterations to Co-operative Stores at Boothstown. Secretary, Leigh Friendly Co-operative Society.
LONDON (E.C.).—Building on southern side of Byward Street. R. M. Roe, Bassishaw House, Basinghall Street, E.C., architect.
(Bermondsey).—Buildings in Tower Bridge Road. Thompson Bros., 155, Fenchurch Street, E.C., engineers.
(Nunhead).—Buildings in Evelina Road and Kirkwood Road. W. L. Dowton, City Bank Chambers, Bedford Row, W.C., architect.
(Hampstead).—Coal office buildings for the Midland Railway Co.
(Norwood).—Buildings in Canterbury Grove. E. B. I'Anson, 7A, Laurence Pountney Hill, E.C., architect.
(Kingsway).—Buildings for Barlow & Roberts, builders, 151, Queen's Road, S.E.
(N. Woolwich).—School. Storey Street. R. L. Curtis, 50, West Hill, Hampstead, N.W., architect.
(Canning Town, E).—Offices for British Alcohol Co. W. Gregar and Son, Plaistow, E., builders.
(Holborn).—Factory for the Imperial Tobacco Co. Spalding and Spalding, 15, Queen Street, E.C., architects.
(Hampstead).—Bank. Langdale, Hallett & Co., 70, Keppell Street, S.W., builders.
(Hammersmith).—Shops in Uxbridge Road. W. G. Ingram, 4, Verulam Buildings, W.C., architect.
(Streatham).—Buildings in High Road. Fasnacht & Beale, 17, Old Queen Street, S.W., architects.
(Clapham).—Addition to Free Home for the Dying. J. C. Stockdale, 16, Hart Street, Bloomsbury Square, W.C., architect.
(Kensington, N.).—15 houses. Trant, Brown & Humphreys, 332, High Road, Kilburn, N.W., architects.
(Southwark).—Buildings in Valentine Place. W. H. Woodroffe, 32, High Street, Boro', architect.
(Holborn).—Mineral water factory. J. Slater, 46, Berners Street, W.C., architect.
MANCHESTER.—Large new sorting offices, in connection with the dock warehouses, Newton Street, Oldham Road. Builders, Edmund Nuttall, Trafford Park, Manchester.
(Trafford Park).—New steel works. Taylor Bros. & Co., owners, Clarence Works, Leeds.
(Waterfoot).—Post office, residence and shop. R. Cunliffe, architect, Waterfoot.
NEWCASTLE-ON-TYNE.—New church (St. Augustine's, £5,000). Hicks and Charlewood, architects, Newcastle; G. H. Manchlen, builder, Moor Street, Newcastle.
NOTTINGHAM.—New premises for Boot's, Ltd., manufacturing chemists.
OLDHAM.—New spinning mill at Waterhead, to be built for the Orb Mill Co.
Large new spinning mill. Potts, Son & Henning, architects, Manchester.
OUNDLE (Northamptonshire).—Enlargements to Grocer's Co.'s Schools. Thompson & Co., builders.
PENGAM and GILFACH FARGOED (Glamorgan).—Two public schools. W. E. R. Allen, County Offices, Westgate Street, Cardiff.
PORTRUSH (Co. Antrim).—New Post Office. A. Ferguson, Scottish Provident Buildings, 2, Wellington Place, Belfast.
PWLLHELI (Carnarvonshire).—Granite quarries to be acquired and worked. Secretary, Co-operative Quarries Co., 59, Great Ormond Street, W.C.
ST. ANDREWS.—Restoration of Parish Church. Builders, J. H. White and Sons, Glasgow.
RADCLIFFE (Lancashire).—Secondary school at Stand. H. Littler, County architect, Preston.
ROCHDALE (Milnrow).—Carnegie library. Butterworth & Duncan, architects, Rochdale.
SALFORD.—Public baths at Weaste. H. T. Bonner, architect, London.
SHAW (Near Oldham).—New spinning mill. Secretary, Duchess Spinning Co., Shaw.
SKIPTON.—Free library. J. W. Broughton and J. Hartley, architects, Skipton.
STAPLEFORD (Notts.).—New police station. H. H. Copnall, Clerk of the Peace, Shire Hall, Nottingham.
STEVENSTON (Ayrshire).—Intermediate school (£2,500). Hugh Thomson, architect, Saltcoats, Ayrshire.
SWANAGE.—Wesley Centenary hall and school. W. T. Clincher & Sons, architects.
TORQUAY.—Garage and stable buildings for A. J. Watson. Watson and Watson, architects, 36, Torwood Street, Torquay.
TREHERBERT (Rhondda Valley).—57 houses for the Margaret Street Building Club. J. D. Walters, Maesgwyn, Treherbert.
WELLINGBOROUGH.—Factory for J. C. Coldicott. Talbot, Brown and Fisher, architects, Wellingborough.
WHALLEY (Blackburn).—County Asylum (£10,000). H. Littler, county architect.
WILLENHALL.—St. Giles's new mission church. J. B. Baker, architect, Willenhall; J. M. Tildesley, builder, Willenhall.
WOLVERHAMPTON.—Hotel, restaurant and shops (Queen Street). A. E. Dempster & Co., architects, Waterloo Street, Birmingham.
WORSLEY.—New technical school. H. Littler, county architect, Preston.

Troubles of the Motor-'Bus.—The Commissioner of Police has addressed a communication to the various omnibus companies on the subject of the dropping of oil and grease from motor-omnibuses, stating that observation shows that in many cases no provision has been made by proprietors to prevent this nuisance, also that in many cases, where trays have been fixed, they have become defective, and that in other cases again oil is allowed to accumulate to such an extent that it splashes over. He, therefore, notifies that one month hence the regulations on this subject will be strictly enforced, and any vehicle found to be defective in this respect will be considered to be unfit for public use and dealt with accordingly.

CONTRACTS OPEN and CLOSED.

OPEN.

Adelaide (S.A.).—July 10th. The Postmaster-General requires tenders for 5 miles of insulated copper wire, two switchboards, two lightning arrester boards, 500 No. 2 Leclanché cells, 12 differential galvanometers, 15 electromagnetic transmitters, six plug pattern registering boxes, 500 copper tapes, 5,000 copper binders. Particulars may be obtained at the Commonwealth Offices, 72, Victoria Street, Westminster.

July 31st. The Deputy Postmaster-General at Adelaide is inviting tenders for a considerable quantity of telegraph and telephone apparatus and material, a full list of which appears in the *Board of Trade Journal* for last week.

Antwerp.—June 17th. The Commercial Intelligence Branch of the Board of Trade have received from His Majesty's Consul-General at Antwerp a specification relating to tenders required by the municipal authorities of that city for electric cables for the Intercalary Docks, at Antwerp. Tenders, in sealed registered envelopes, to M. le Bourgmestre de la Ville, at the Hotel de Ville. Deposit £200. Specifications obtainable from the Hotel de Ville, at Antwerp. Copies may be inspected by British traders at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Belfast.—June 15th. Coal bunkers and electric travelling crane for the Corporation. See "Official Notices" May 31st.

Belgium.—The municipal authorities of Ans, near Liège, are at present inviting tenders for the concession for the private and public electric lighting of the town, and for the supply of electrical energy for power purposes.

Darlington.—Steam and exhaust pipes. See "Official Notices" June 7th.

Eastbourne.—June 29th. Supply and erection of water-tube boiler, steam and water piping, for the T.C. See "Official Notices" June 7th.

Hackney.—Tenders are to be invited for (1) the wiring, etc., of the Central Library, and (2) the purchase of discarded Worthington pumps and scrap metal.

L.C.C.—July 9th. Two 5,000-kw. three-phase steam turbo-generators with surface condensers, &c., for East Greenwich tramways generating station. See "Official Notices" to-day.

London, E.C.—June 24th. Electric light installation for the stage of the Central Club Society, Ltd. See "Official Notices" June 7th.

London.—Hackney.—June 27th. Electric light installation for the Central Public Library. See "Official Notices" June 7th.

Manchester.—June 18th. Twelve months' supply of motors and motor-starters, meters, &c., for the T.C. See "Official Notices" June 7th.

Melbourne (V.).—June 20th. Supply of 438,000 flame and 24,000 ordinary carbons. See "Official Notices" June 7th.

Newport (Mon.).—July 1st. Switchboard, motor alternators, battery, cooling tower, battery reversible booster, &c., for the Corporation. See "Official Notices" to-day.

Perth (W.A.).—August 6th. Desiccating apparatus with motor-driven air-pump for telephone cable work for the Deputy Postmaster-General. Specifications at the Commonwealth Office, 72, Victoria Street, S.W.

Portsmouth.—June 24th. Supply and erection of 1,000-kw. turbo-alternator, with condensing plant and accessories, for the T.C. See "Official Notices" June 7th.

Servia.—June 28th. The municipal authorities of Schabatz are inviting tenders until the 28th inst. for the establishment of a central electric lighting station in the town.

South Shields.—June 22nd. Stores for the Corporation tramways department. See "Official Notices" to-day.

Spain.—Tenders have just been invited by the municipal authorities of Salvatierra de los Barros (province of Badajoz) for the concession for the electric lighting of the town.

Spain.—June 30th. Tenders are being invited until the 30th inst. for the construction of an electric tramway in the town of San Sebastian.

Stepney.—July 1st. Meters, demand indicators and arc lamp carbons for the Electricity Committee. See "Official Notices" to-day.

Swindon.—June 17th. Tramway tickets and punches, and advertisements on tickets and tramcars. See "Official Notices" June 7th.

Tasmania.—July 29th. Telephone subscriber service meters, racks, and cable for the Deputy Postmaster-General at Hobart. General and special conditions, &c., can be seen at the General Post Offices at Hobart, Sydney, Melbourne, Brisbane, Adelaide and Perth.

Victoria.—July 16th. The Deputy Postmaster-General requires tenders for cable, switchboards, telephones, and various telephone and telegraph apparatus. Detailed specifications may be seen at the office of the officer representing the Commonwealth of Australia in London, Captain Collins, C.M.G., 72, Victoria Street, Westminster, S.W.

Walthamstow.—June 14th. Cables for the U.D.C. See "Official Notices" June 7th.

Wimbledon.—June 17th. Flame arc lamps and lamp columns for the Corporation. See "Official Notices" May 31st.

CLOSED.

Austria.—Messrs. Breitfield, Danek & Co., of Prague, have recently secured a contract from the Vienna municipal authorities for the supply and erection of a 500-H.P. steam turbine on the Melins-Seninger system at the municipal central electricity station.

Bristol.—The Docks Committee of the T.C. has accepted the tender of Messrs. Royce, Ltd., for two electric capstans, and that of Messrs. Tannett, Walker & Co. for an accumulator for the hydraulic machinery.

Colne.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., for a generating set, at £2,350, and that of Galloways, Ltd., for a boiler, at £670.

Coventry.—The Corporation electricity department has ordered mechanical coal and ash handling plant, &c., from Messrs. E. Bennis & Co., Ltd., at £3,279, as mentioned in our "Business Notices" to-day. A repeat order has also been placed by the Corporation with this firm for six chain-grate stokers (Bennis-Miller-Bennett patents). The work is to be completed by August.

Derby.—The Electricity Committee has accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply of "Paterson's" vulcanised bitumen cables.

The Council has accepted, on the recommendation of the Sanitary Committee, the tender of Messrs. Meldrum Bros., Ltd., Timperley, Manchester, for the application of the Meldrum patent system of steam jet forced draught to the existing destructor cells at their depôt, with a view to improving the working and capacity of the installation.

Felixstowe.—The U.D.C. has accepted the tender of Messrs. Whipp & Bourne for the supply of a switchboard, at £579.

Holland.—The Oerlikon Co., of Oerlikon, Switzerland, has submitted the lowest tender for the supply of two steam-turbines and dynamos of 4,000-KW. capacity, required for the extension of the municipal electricity undertaking in Amsterdam.

Ivybridge.—The U.D.C. has accepted the tender of Mr. Heath for forty 50-C.P. lamps, at 44s. each.

Krugersdorp.—Messrs. Bruce Peebles & Co., Ltd., have received an order for six generators, being the electrical power plant for the new Krugersdorp municipal lighting scheme.

London.—HACKNEY.—The following orders have been placed by the B.C. for the supply of coal for the electricity works:—

Rose & Co.—Granville and Exhall mixed, 10s. per ton; Staffordshire slack, 10s. per ton.
Phillips & Co.—West Hallam nutty slack, 12s. 6d. per ton.
Kaye, Son & Co.—Norton Cannock seconds, 18s. 8d. per ton.

L.C.C.—The Education Committee of the L.C.C. has accepted the tender of A. W. Penrose & Co., amounting to £462, for the provision and erection of electrically-driven goods and service lifts at the Central School of Arts and Crafts, in Holborn.

The tender of Rowlingsons & Co., amounting to £2,941, has been accepted by the Highways Committee of the L.C.C. for the partial reconstruction of the Sparta Street and Plough Bridges, in connection with the tramways from Greenwich to Lewisham.

SOUTHWARK.—The B.C. has received the following tenders for installing electric and, to a small extent, gas lighting in the Old Kent Road Library:—

W. Winn	£301	W. G. Cannon & Sons (provisionally accepted)	£241
Smeeton & Page	284	Strode & Co.	239
Vaughan & Cook	276	H. J. Godfrey	239
Boaz & Co.	276	A. Wootton & Co.	236
Hoskins & Co.	274	D. Hulett & Co.	232
F. V. Slatter	272	Stubbs, Son & Hall	227
Pemberton, Arber & Co.	263	Reliance Electrical Co.	223
Grant & Taylor	246	Allan & Co.	218
Weston & Sons	244	Frizell Bros. & Louis	193
S. & G. Cozens	242	Waring & Withers	191
Tilley Bros.	242		

HAMMERSMITH.—The B.C. has received the following tenders for the supply of cables:—

Land & Sea Cable Works, Ltd.	£1,949
Union Cable Co.	1,973
Lahmeyer Electrical Co.	2,122
Rumney & Rumney	2,214
Western Electric Co. (accepted)	2,255
Johnson & Phillips, Ltd.	2,333
British Insulated & Helsby Cables, Ltd.	2,340
W. T. Glover & Co.	2,359
Siemens Bros. & Co.	2,362
W. T. Henley's Telegraph Works Co.	2,366
Callender's Cable & Construction Co.	2,398
St. Helens Cable & Rubber Co.	2,523

The Electricity Committee, in its report, said that the first four tenders were for foreign made cables, whereas the quotation of the Western Electric Co. is for English made cables, and as the contracts placed by the Council with the Western Electric Co. in the past have been executed with entire satisfaction, the Committee had accepted that company's tender.

The B.C. has accepted an offer to supply 6,000 tons of "Thro' and Thro'" coal, at 18s. per ton. This was the price quoted in March last, when it was deemed inadvisable, having regard to the then high price of coal, to enter into a contract for a 12 months' supply. As there appears to be no prospect of prices being reduced in the immediate future, tenders are to be asked for from 2,500 to 3,000 tons of coal, being the estimated quantity required for the next few months.

Salford.—The T.C. has accepted the tender of Messrs. Sirius & Werkes for the supply of carbons for arc lamps.

Wallasey.—The U.D.C. has accepted the tender of Messrs. Dryland & Preston, of Littleborough, for extensions to the car-sheds, at £5,416. Twelve tenders were received, the highest being £5,870.

War Office.—A contract has been placed with the Bryant Trading Syndicate, Ltd., by the War Office, for their ordinary Royal Glow and their patent Royal Glow switch lamps.

Warrington.—The T.C. has accepted the tender of Messrs. McDowell, Ltd., for the supply of six tramcar covers, at £85 each.

West Ham.—The Electricity Committee has considered tenders for mechanical stokers and cooling towers, and has decided to accept none of them. For a rotary converter for the supply of current to Messrs. Knight's premises, the tender of the Fuller Electrical Co., at £225, has been accepted. A further order has been placed with the Fuller Co. for a second rotary, at £400.

The Corporation has accepted the tender of W. F. Lucy & Co., at 2s. 5½d. each, for the annual supply of house cut-out boxes. No tender is to be accepted for the annual supply of electrical accessories, but the engineer is to purchase from time to time as required at the lowest prices quoted by the firms for the various items.

FORTHCOMING EVENTS.

Friday and Saturday, June 14th and 15th.—Meeting of the Institution of Mining Engineers at Burlington House, London. The visits include one to Park Royal generating station of the G.W. Railway.

Wednesday to Friday, June 19th to 21st.—Engineering Conference at Westminster.

Thursday, June 20th.—At 8.30 p.m. Chemical Society, Burlington House. Ordinary meeting. Among the papers is one on "Some Properties of Radium Emanation," by A. T. Cameron and Sir W. Ramsay.

Tuesday to Friday, June 25th to 28th.—Meeting of the Incorporated Municipal Electrical Association at Sheffield.

NOTES.

Postmaster-General v. The National Telephone Co.—On Tuesday a motion came before Mr. Justice Swinfen Eady in the Chancery Division of the High Court, asking his Lordship to vary the minutes of the order made in the special case raising various points of law in this action. The special case, which was argued before his Lordship three months ago, was decided in favour of the Postmaster-General, and was reported in the ELECTRICAL REVIEW at the time. The Solicitor-General, who now supported the motion, said he wished the minutes of the order varied by adding "and it is adjudged that the plaintiff recover from the defendants costs to be taxed." The special case raised all the questions of fact and law between the parties, but it did not contain a question as to the costs. After argument, his Lordship said that judgment was delivered in the special case simply answering the questions submitted, and when the question was

asked whether he dealt with the question of costs, Mr. Eve said he (his Lordship) was not asked to do so, and that was acquiesced in. He did not consider the matter further, concluding that as neither party had asked the question they had good reason for not doing so. He did not consider himself at liberty now to reopen the matter, and the motion must be dismissed with costs.

Exhibition.—It is stated that the seventh Ironmongery, Hardware and Electrical Trades' Exhibition and Market will be opened at the Royal Agricultural Hall on July 9th.

Subways for Pipes.—The L.C.C. Highways Committee, in the course of a report presented at Tuesday's meeting of the L.C.C., referred to the amended by-laws made in 1902 regulating the use of subways for pipes and wires. The Board of Trade had not seen its way to allow the insertion in the by-laws of a general charge for the use and supervision of subways to be constructed in the future, but had allowed charges to be inserted in respect of the subways in Southampton Row, Kingsway, Aldwych, and the Strand. Accordingly the amended by-laws had been re-drafted, and apart from those additional charges, the new amended by-laws were practically identical with those existing. The Committee, therefore, recommended the Council to make the by-laws and fix a scale of fees for the use of the subways, leaving the question of new subways for future legislation.

Copper.—Statistics are now to hand from Messrs. Merton for the end of May, and we notice that visible supplies, although equal to the quantity apparent on the 15th ult., are below the figure for April 30th (11,729 tons against 12,958). Chile has put some 200 tons more on the water, the quantity crossing from Australia remaining the same. Re-shipments are fairly maintained, 400 tons of "standard" leaving Liverpool and Swansea for America during the month. The outputs for the month show an advance in the quantity supplied to Europe from North America, and a falling-off in the quantities for Australia and Chile. The supply from Spain and Portugal to England and France is below last month by 188 tons. The price given, £101 per ton, although considerably below that for the end of February (£108) is still high for the consumer, and it is difficult to see why the increase in supplies is delayed.

Platinum.—The *Mining World* quotes a statement, attributed to a member of the Imperial Russian engineers, with regard to the platinum industry to the effect that over 65 per cent. of the 210,318 oz. of platinum produced in Russia last year was controlled by a so-called trust, which sells through Paris and London, and from 1898 to 1906 has advanced the price of ingot metal from $10·21 to $38·80 per oz. troy. Prices in London in the current year have been shaded from $34·02 per oz. in January to $33·69 in April, and in New York in the third week of May the quotation was as low as $32 per oz. Even if the price is cut 25 per cent. it is likely that the so-called Franco-British platinum combination will still be doing business at a profit, for it is known that its contracts with the Russian miners have been placed at very low prices (about $12.15 per oz. for 82 per cent. crude metal). On the other hand, the late rise in prices has not encouraged a corresponding increase in production, primarily because the miners believe they would do better by waiting until the expiration of their contracts with sellers affords the opportunity to demand more money.

Institution and Lecture Notes.—Röntgen Society.—Mr. Alan A. Campbell Swinton, M.Inst.C.E., lectured before the Röntgen Society on June 6th, on "Some Recent Investigations in Connection with Crookes Tubes." He dealt for the most part with what Prof. J. J. Thomson has lately described as the most promising field of investigation in electrical phenomena, that of positive radiation. Mr. Swinton had been making a number of experiments in order to see whether the "Kanal-strahlen," or positive rays, would produce rotation of a mica mill in the same way as the cathode rays. He found that the rotation was not so violent as in the case of the cathode rays, but it was quite definite. He next addressed himself to the question whether the rotation of the mica vane was due to the direct push of the "Kanal" ray particles, or was a secondary effect due to differences of temperature on the two sides of a mica vane. In the case of the cathode rays the effect of the direct push was altogether too slight to account for the rotation, and one was driven to the conclusion that the result in this case was a secondary one, due to the cathode rays making the mica vanes very much hotter on one side than on the other. By means of a thermal junction apparatus, Mr. Campbell Swinton found that the difference of temperature between the two sides of a mica vane, which was bombarded on the one side by the "Kanal" rays, might amount to as much as 200° F. This would be quite sufficient to account for the rotation. But he had made further experiments with mill-wheels having aluminium vanes. The aluminium was ·0005 in. in thickness, and it was difficult to believe, he said, that within an appreciable time there could be any appreciable difference of temperature in so thin a piece of aluminium. The curious circumstance was noted, however, that whereas the mica vane, under "Kanal" ray bombardment, went round in one direction, the aluminium vane, under the same bombardment, went round in the opposite direction. In order to elucidate this matter, further experiments are necessary. Mr. Campbell Swinton's experiments go to suggest that the "Kanal" ray effect is a direct one, the turning of the mill wheels being due to the push of the rays, and the cathode ray effect is an indirect one, due to the heat. He sums up his conclusion as follows: that the total energy or heating effect of the cathode rays is greater than that of the "Kanal" rays, but the momentum of the "Kanal" rays is greater (possibly 40 or 50 times greater) than that of the cathode rays. In reply to a question, Mr. Campbell Swinton stated that he took the greatest care to ensure that there were no cathode rays interfering with his experiments upon "Kanal" rays. The "Kanal" rays are only slightly deflectable by a magnet, not to anything like the extent to which the cathode rays are deflectable, and he subjected the tube to a very strong field, by which means all cathode rays would be swept on one side.

Illuminating Engineering Society (U.S.A.).—This Society will hold its first annual convention at Boston, U.S.A., on Tuesday and Wednesday, July 30th and 31st. In addition to a number of papers from leading representatives of the various interests which the membership includes, there is to be an exhibition of illumination appliances and measuring apparatus.

Manchester Geological and Mining Society.—Mr. G. G. L. Preece, at a meeting of this society, on June 11th, read a paper on some recent improvements in the design of electrical cables for collieries. He described two improvements, both of which, he said, were valuable as they resulted in increased efficiency and length of life, compared with cables hitherto designed and manufactured for colliery purposes. The first was not an entirely new type of cable, but a special feature in connection with that basis of all insulated electric cables—namely, a stranded copper conductor. The speciality is called the patent solid strand filling, and consists of the filling up of the interstices between the wires composing the strand with a special solid compound which will not run or become displaced by the heating of the conductor through overload. The centre wire and each succeeding layer of the stranded conductor is covered with a thin tube of plastic bituminous compound, by which means damp is absolutely excluded—an important matter in colliery cables. The second improvement described represented an entirely new type of cable, called the patent solid three-core bitumen cable. The conductors are each separately insulated with bituminous compound, then laid together around a shaped core of bitumen, which fills up the central space, and is sheathed over all with a solid tube of bitumen, which is so forced on as to be ribbed internally and exactly fits the interstices between the three cores. The cable can then be taped and protected by armour, &c., as may be necessary. The cable, being three-core, is for use with three-phase alternating current. This new type of cable has many advantages. It has higher insulation and dielectric strength, greater chemical protection against bad water, greater reliability in wet situations, greater mechanical protection of the cores, &c. There should, Mr. Preece said, be no hesitation in suspending this type of cable by itself for a distance of 400 yards. The distance in practice is limited by the weight of the cable. In fact, a cable 400 yards long, so suspended, and weighing about 5 tons, is to be installed during the next two or three weeks in a colliery shaft near Stoke. The patents for the two improvements described belong to Messrs. W. T. Glover & Co., Ltd., of Trafford Park.

In a brief discussion which followed the reading of the paper, the improved forms of cable (of which samples were exhibited), were highly spoken of for colliery purposes, though one or two practical mining engineers expressed some doubt as to whether a cable weighing 5 tons could safely be suspended from the surface down a pit-shaft 400 yds. deep.

Mr. Preece was cordially thanked for his paper.

Institution of Civil Engineers, Engineering Conference.—Amongst the subjects to be discussed at the Conference next week, the following are of direct electrical interest:—"Dock Equipment, Including the Relative Advantages of Electric and Hydraulic Appliances," introduced by Mr. W. W. Squire; "Arrangement and Design of Colliery Surface Works," Mr. E. M. Hann; "Design and Equipment of Shafts for Deep Winding," Mr. C. E. Rhodes; "Problems of the Witwatersrand Goldfields," Mr. G. A. Denny; "Electro-Metallurgy," Mr. B. Blount; "Welding of Structural Materials in Place," Mr. H. A. Ruck-Keene; "Arrangements for Working Cargo on Ships," Mr. W. H. Dugdale; "Comparative Cost of Pumping by Steam, Internal Combustion Engines and Electricity," Messrs. C. Hawksley and H. Davey; "Modern Applications of Electricity to Mines," Mr. C. P. Sparks; "Electrical Transmission Gears on Motor-Vehicles," Mr. A. A. C. Swinton; "Application of Electricity to the Working of Railway Points and Signals," Mr. L. de M. G. Ferreira; "Upkeep Charges on Large Electric Generating Sets," Messrs. H. R. J. Burstall and J. S. Highfield.

There are also several other subjects of less direct interest to electrical men.

Anthrax Preventative.—It is reported that Mr. Harry Hay, of Dewsbury, has discovered that by immersing woollen rags in an electrolytic solution, and passing a current of electricity through them they are effectively sterilised, and anthrax germs are destroyed, without injury to the wool.

Appointments Vacant.—Station superintendent for Partick electricity department; chief assistant electrical engineer for Dewsbury (£150); Hammersmith Borough Council are to appoint a canvasser for the electricity undertaking at a salary of £3 a week; an electrical engineer (£72 + allowances = £33) for Londonderry District Lunatic Asylum. Applications by June 21st; junior lecture assistant in the electrical engineering department at Northampton Institute.

The Electric Supply Football League.—A meeting will be held at the offices of St. James' Electric Light Co., Carnaby Street, Regent Street, W., on Tuesday June 18th, at 6.45 p.m.

For Sale.—The Bolton Corporation Tramways Committee is inviting tenders for the purchase of scrap metal. The Metropolitan Asylums Board is offering various second-hand electric generating plant, crane, &c., for sale. On June 19th, Messrs. P. Huddleston & Co., will offer for sale by auction the stock of an electric supply stores. See "Official Notices" in this issue.

Golf.—In delightful weather, a golf contest between the respective staffs (six a-side) of Messrs. Dick, Kerr & Co. (London office) and Metropolitan Electric Tramways Co., was played over the Enfield G.C. links on Tuesday, the 11th inst., resulting in a victory for the latter by 5 points to 1 in the singles and 2 points to 1 in the foursomes, making a total of 7 points to 2 on the day's play. The links were in splendid condition, and a vote of thanks was heartily accorded the G.C. Committee for their courtesy. One hopes to see many other engineering firms adopting similar meetings under equally pleasant social and local circumstances.

R.E. (Vols.) Electrical Engineers. — The *London Gazette* for June 11th contains the following:—

"War Office, Whitehall,
"June 11th, 1907,

"The King has been graciously pleased to approve of the Royal Engineers (Volunteers) Submarine Miners, and Royal Engineers (Volunteers) The Electrical Engineers, being in future designated 'Royal Engineers (Volunteers) Electrical Engineers.'"

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Canterbury T.C. has increased the salary of the electrical engineer, Mr. C. A. BLASCHECK, from £300 to £325 per annum.

The Aston T.C. has increased the salary of Mr. FOSTER, electrical engineer, from £300 to £400 per annum.

Mr. L. L. HORRELL has resigned his position as engineer-in-charge at the Walsall Corporation Electricity Works, to take up a post as electrical engineer to the Edendale Estates Co., Ltd., at Hatherley, South Africa.

Mr. DAVID SMITH, A.M.I.E.E., was at the last meeting of the Town Council appointed resident engineer to the Borough of Tunbridge Wells.

The Bolton T.C. on 5th inst., approved a recommendation of the Tramways Committee that the salary of Mr. A. A. DAY, borough electrical engineer and tramways manager, be advanced £50 per annum, making it £750. The increase was unsolicited.

The St. Helens Electricity Committee has recommended the T.C. to increase the salary of Mr. HOLLINGWORTH, electrical engineer, from £400 to £425 per annum.

The Manchester T.C. has granted the following increases of salary:—Mr. A. E. M'KENZIE, resident electrical engineer, Stuart Street Station, from £350 a year to a maximum of £500 by £50 per annum; Mr. F. E. HUGHES, secretary of the electricity department, from £400 to £425; Mr. L. R. LEE, mains engineer, from £350 to £450, by £25 a year; Mr. F. H. WHYSELL, resident engineer, Dickinson Street and Bloom Street stations, from £280 to £325.

Mr. ALEX. P. DRYBURG is leaving the position of chief assistant engineer at the Dewsbury Corporation Electricity Works to take up a position with Messrs. Joshua Buckton & Co., Ltd., Engineers, Leeds.

On Friday evening last a smoking concert and social gathering was held at St. Stephen's Restaurant, Baldwin Street, in connection with the departure of Mr. J. H. BOLAM, of the Bristol Corporation electricity department, who has been appointed to the position of borough electrical engineer at Weymouth. In the unavoidable absence of Mr. H. Faraday Proctor (who is out of England), Mr. Herbert Couzens (deputy city electrical engineer) presided. A varied and lengthy musical programme was provided, and during the course of the evening a handsome stop watch (subscribed for by the staff and employés) was presented to Mr. Bolam.

Tramway Officials.—The members of the Leyton Tramways Athletic and Social Club have presented an oak-framed photo-enlargement of himself to Mr. F. SCHOFIELD, tramways manager, as a token of esteem.

The Manchester T.C. has increased the salary of Mr. J. T. OAKES, tramway traffic superintendent, from £400 to £425 per annum.

General.—On 5th inst. the staff of the P.O. Western telephone exchange met to present to Mr. R. W. CALLENDER various books, &c., as a mark of esteem on his promotion to the charge of the Ealing exchange. Mr. J. Mackenzie was in the chair and made the presentation.

At the parish church, Atherton, Bolton, on June 6th, Mr. E. H. EDWARDES, resident engineer to the Lancashire United Tramways Co., was married to Miss Eleanor Matilda, second daughter of the Rev. W. Nuttall, vicar of Atherton. Amongst the numerous and costly presents were a silver spirit kettle and smoker's cabinet from the officials and employés of the Tramways Co.

We are asked to state that Mr. C. S. NORTHCOTE is now away on the Continent, but he will be personally available for business again, on and after Monday, June 24th.

Mr. SIDNEY ALEXANDER HARRIS, chief electrical engineer to the Earl of Warwick, was married last week to Miss Annie Emily Coote. Amongst the presents were a silver cabinet from the Countess of Warwick, and a dinner service from Lady Helmsley.

Mr. ALFRED E. GARBUTT, has resigned his position as manager of the cable department of Messrs. I. Frankenburg & Sons, Ltd., of Salford, and has accepted the appointment of general manager of the new Gutta Percha Co., Ltd. He leaves Messrs. Frankenburg next week, and takes up his new duties on 24th inst., on and after which date his address will be Dashwood House, New Broad Street, E.C.

The employés of Messrs. Brook, Hirst & Co., electrical engineers, Northgate, Chester, have presented a silver rose bowl and a pair of silver candlesticks to Mr. P. S. BROOK, on his marriage. From the office staff he received a pair of silver flower vases.

Mr. W. H. TURNER, A.M.I.E.E., has resigned his position of chief engineer and manager of Messrs. S. Dixon & Son, Ltd., Leeds, which he has held for over six years, to take up the appointment of managing director to Tramway Supplies, Ltd., Leeds and London.

Obituary.—The death has occurred of Mr. JOSEPH HALDEN, of the firm of J. Halden & Co, electrical appliance dealers, of Newcastle-on-Tyne, Manchester and London. Deceased, who was 65 years of age, had had charge of the firm's business for 30 years. He was a prominent Freemason.

CITY NOTES.

The Diesel Engine Co., Ltd.

THE directors' report for the year ending March 31st, 1907, recommends a dividend of 5 per cent., free of income-tax, on both ordinary and preference shares for the period. The credit balance of profit and loss account is £11,213, to which has to be added £277 brought forward from the last financial year, making a total of £11,489. The 5 per cent. dividend now proposed will absorb £5,000, and the directors suggest placing £3,000 of the balance to a general reserve account, and carrying forward £3,489 to the current year. The gross profits during the period for which the accounts are issued amount to £20,113, against £12,648 in 1905-6, and £7,405 in 1904-5. The directors are pleased to be able to state that, notwithstanding this large increase in the profits, there has been an actual decrease in the expenses connected with the management. The value of orders booked during the period under review is nearly treble that of the previous year, and as a considerable proportion of these orders has been carried forward, the company may well anticipate greatly increased prosperity in the immediate future. All advances on the floating debentures had been cleared off at March 31st, 1907. Messrs. Willans & Robinson, of Rugby, who manufacture for the company under agreement, are now supplying engines, and several made by this firm have already been sold. The directors are pleased to state that the scheme for the reduction of capital, referred to in the last report, has now been successfully carried through. Since the last ordinary general meeting the directors decided to invite Dr. Mackew, of Messrs. S. Pearson & Son, Ltd., to join the board, which invitation was accepted.

Lisbon Electric Tramways, Ltd.

THE directors' report for the year ending December 31st, 1906, says that the result of the company's operations for the year, after deducting interest and amortisation due on the debentures of "Companhia Carris de Ferro de Lisboa," and after the payment of £25,000 for interest on the debentures of this company, and the payment of London office expenses and directors' remuneration, shows a net profit of £96,118, which, added to the balance of £16,096 brought forward from last year, gives a balance of £112,214. From this amount £35,000 has been placed to depreciation, bringing this account to £110,000; and £5,000 has been added to the credit of exchange reserve account, making the total of this account £15,000. After providing for the above, an available balance of £72,214 remains, out of which the usual preference dividend amounting to £25,533 has been paid, and the directors now recommend the payment of a dividend of 5 per cent. for the year 1906, amounting to £29,709, on the ordinary share capital of

£594,188, leaving a balance of £16,971 to the credit of profit and loss, to be carried forward. During the year under review 100,000 ordinary shares of £1 each were offered to the shareholders, of which 94,188 were subscribed for. The premium on the same amounted to £19,013, which had been placed to the reserve fund. The operations of the company during the past year again showed an advance on the previous year's figures. In order adequately to cope with the increase of traffic and extensions of the system, a capital expenditure of £47,000 had to be made for the completion of new lines, additions to power plant, and for increased rolling stock. The Santa Justa Elevador, on which the company had an option, had been leased on favourable terms for the remainder of its concession. This elevator forms a connecting link between the lower and upper town, and increases the travelling facilities of the public. Count Henry de Burnay joined the board in June, 1906. Mr. William Bremer Rommel was elected director and appointed managing director on October 3rd, 1906; and the shareholders are asked to confirm his election. The directors again testify to the valuable services rendered during the year by the directors of the local board in Lisbon, and also by Mr. William Clark, the general manager, and by the entire staff.

Madras Electric Supply Corporation, Ltd.

The directors' report to December, 1906, states that the site for the generating station, referred to in the prospectus, has been acquired. The erection of the buildings is progressing, and the contractors have made a satisfactory commencement of the work of laying the mains. It has been found necessary to increase the amount of the contract for the station buildings, and for some extensions of mains required to reach intending consumers. In consequence of pressure in the demands for current, temporary plant has been purchased and forwarded to Madras, where it is expected to be erected and set to work in the course of the present month. The directors have ordered a number of electric fans, which it is proposed to hire out or to sell at moderate prices. A table of charges for energy has been arranged, and every effort will be made to popularise the use of electricity. Messrs. Binny and Co., Ltd., have been appointed managing agents of the company in Madras. From the number of inquiries which have been received, the directors have every confidence in the future success of the Corporation.

Birmingham and Midland Tramways, Ltd.

The meeting of this company was held on Thursday of last week at Donington House, Mr. C. S. B. Hilton presiding.

In moving the adoption of the report (see Electrical Review, June 7th, page 936), the Chairman said that it was with pleasure the directors were able to present such a good balance-sheet, and they felt that all the more strongly because they had had an exceedingly difficult and anxious year. During the year they had increased the debenture issue by £80,000, and the total now stood at £355,000, less the amount redeemed and cancelled under the provision of the trust deed. The loan from the B.E.T. Co. remained at the same figure as last year, and it would be settled when the purchase of their lines in Dudley was completed by the Corporation. They had hoped that it would have been settled before now, but the matter had been carried from Court to Court, and that day they were no nearer a settlement than they were this time last year. Last year they made no addition to the depreciation and reserve fund. This year, however, the directors had thought it prudent to commence building up a depreciation and renewal fund. That was a fund which they would add to, and take from, from time to time as occasion might require. That provision was in addition to the amount which they had provided for redeeming and cancelling debentures, which was in the nature of a reserve. The capital expenditure had been increased during the year by some £8,000, less amounts that they had received. The investments stood at very much the same figure as last year, and were taken in the balance-sheet at cost price. The gross revenue from all sources was £92,582, as against £116,643 in the previous year, or a decrease of £24,000. The sale of the omnibus business to a separate company had accounted for about £12,000 of that decrease, and the remainder of the £24,000 was the loss in the gross receipts caused by the sale of the tramways in Birmingham to the Corporation. On the other hand, the expenses had decreased by £29,513. The sale of the omnibus undertaking accounted for £14,000 of the decrease, £5,000 was due to the lesser rents payable to the Birmingham Corporation, and £5,000 was due to a saving in rates; the remainder was saved under various heads, the result being a net balance, after charging £2,500 to depreciation and renewals, of £33,517, as against £28,866 last year, and the directors regarded that as very satisfactory, and one which he might frankly tell them they had not anticipated. The year had been one of considerable anxiety. It was quite uncertain what the effect would be on the general interests of the company, and especially on their net revenue when they lost the lines inside Birmingham, and it was therefore a matter of great congratulation and of great relief to the directors to find that the saving in rents, rates and expenses, had more than neutralised the loss they had made in the gross receipts. During the year they had been able to negotiate a fresh lease in Smethwick which had extended the company's tenure to 35 years from 1902. As to the supply of power, at the same time as they negotiated a fresh lease for the tramways the opportunity was taken to negotiate for the transfer of the Smethwick Lighting Order to the company, and after many difficult negotiations they were able to carry it through successfully, and that transfer was now before the B. of T. for approval. They hoped that the change would facilitate the business, and they looked forward with every confidence to the future. The business had steadily increased and was increasing. They already supplied several private firms in Smethwick with power, and indications were not wanting that the business would steadily increase. They had 12·10 miles of lines now as compared with 14·65 in the previous year. They carried 13,255,000 passengers, or a decrease only of 2,324,000, which was entirely due to the loss of lines inside Birmingham; but, in spite of that, they had made better profits. They had taken an average of £4,850 per mile, which he considered was a very good result compared with other undertakings. Since the introduction of electric traction there had been a constant tendency to reduce fares, with the result that the average fares had now fallen from 1·6 pence 20 years ago to 1·1 pence; and further, they carried passengers much farther and much faster, and gave far better accommodation, while, in some instances, workmen were carried 3 miles for a penny. It was generally felt that those reductions had been carried too far in deference to socialistic opinions, and he thought the time had come when some effort should be made to check further reductions.

Sir Ernest Spencer seconded the motion, and the report was adopted.

Sheerness and District Electric Power and Traction Co., Ltd.—The report for 1906 states that the receipts from the light railways amounted to £3,206, and from the electricity supply to £2,939. There was a loss on the year's working of £498. Adding this loss to the debit balance of £178 from last account, there is a debit of £676 to be carried forward. The capital expenditure at the end of the year amounted to £64,800. Owing to the reduction of employment at the dockyard, very little money was circulated in Sheerness during the past year. This was markedly felt in the traffic receipts on the light railways, and notwithstanding every effort to reduce the expenses to a minimum, the result has been disappointing. The falling-off in receipts towards the close of the year was so pronounced that it became necessary entirely to rearrange and reduce the services, and a universal 1d. fare was instituted with a view to encouraging traffic. The changes effected have so far been justified by results. The curtailing of the light railway service naturally affected the output from the power station, which, however, shows but a slight decrease. Excluding the traction demand there has been an increase of £107 in the amount received from sale of energy, and the installations connected to the mains at December 31st, 1906, represent the equivalent of 9,017 8-c.p. lamps as compared with 7,120 8-c.p. lamps at the end of 1905. Arrangements having been made with leading manufacturers in Queenborough to use electricity in place of steam power, the directors decided to extend the mains into this district and to make the necessary additions to the power house. These extensions were commenced early in the present year, and it is expected to have them in operation by the end of next month. It is believed that in due time these developments will be the means of earning a fair return on the capital invested. The meeting was held in London yesterday.

Vallambrosa Rubber Co., Ltd.—It is reported that the directors have declared a final dividend of 8s. per share, making 55 per cent. for the year.

Altrincham Electric Supply Co., Ltd.—The annual general meeting of this company was held on 6th inst., when it was shown that the progress of business to the end of 1906 was very satisfactory. Of the year's profits, after meeting loan and debenture interest, the directors propose to put £2,000 to reserve for depreciation account, and to recommend a dividend of 5 per cent. on the ordinary shares, leaving £351 to be carried forward.

Highlands and Lowlands Para Rubber Co., Ltd.—At the first annual meeting, held on 6th inst., a dividend of 11 per cent. per annum was declared. The company's estates produced for the year 134,285 lb. of rubber, which sold at 5s. 2¾d. per lb., and yielded a profit of £34,110. The estimated production for the present year is 200,000 lb.

Prospectuses.—*Tyneside Tramways and Tramroads Co. Ltd.*—It is stated that this company will shortly issue a prospectus offering £30,000 of preference shares for subscription.

The Simo Rubber Estates, Ltd.—This company has been inviting applications for an issue of 30,000 shares of £1 each, to acquire and develop a group of estates in the State of Soerakarta, Java.

Stock Exchange Notices. — The Committee has appointed Wednesday, June 19th, as a special settling day in:—

National Telephone Co., Ltd.—200,000 new shares of £5 each, £1 10s. paid, Nos. 990,000 to 1,190,000.

And ordered the undermentioned securities to be quoted in the "Official List":—

Anglo-Malay Rubber Co., Ltd.—Further issue of 10,000 of £1 each, 12s. 6d. paid, Nos. 140,001 to 150,000.

Canadian General Electric Co.—The usual quarterly dividend of 2½ per cent. has been declared.

Belgium.—La Société Belge pour la Fabrication des Cables et Fils Electriques, of Brussels, is increasing its capital to £40,000.

MARKET QUOTATIONS.

Wednesday, June 12th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a " Nitric	per cwt.	22/-	..
a " Oxalic	per cwt.	32/-	..
a " Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a " "	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Copper Sulphate	per ton	£33 10	..
a Lead, Nitrate	per ton	£33 10	..
a " White Sugar	per ton	£35	..
a " Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£30	..
a " Chlorate	per lb.	3½d.	..
a " Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	220/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a " Recovered	per ton	£5 10	..
a " Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a " Chlorate	per lb.	3½d.	..
a " Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a " Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£200	..
b " Wire, in ton lots	per ton	£220	..
b " Sheet, in ton lots	per ton	£210	..
p Babbitt's metal ingots	per ton	£60 to £192	..
c Brass (rolled metal 2" to 12") basis	per lb.	10¼d.	1d. dec.
c " Tube (brazed)	per lb.	1/0½	..
c " " (solid drawn)	per lb.	10¾d.	¾d. dec.
c " Wire, basis	per lb.	11d.	..
c Copper Tubes (brazed)	per lb.	1/2	..
c " " (solid drawn)	per lb.	1/1½	¾d. dec.
g Copper Bars (best selected)	per ton	£116	£4 dec.
g Copper Sheet	per ton	£118	£4 dec.
g " Rod	per ton	£116	£4 dec.
e " (Electrolytic) Bars	per ton	£112	£5 dec.
e " " Sheets	per ton	£121	£4 dec.
e " " Rod	per ton	£117	£4 dec.
e " " H.C. Wire	per lb.	1/1½	½d. dec.
f Ebonite Rod	per lb.	8/8	..
f " Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/8	..
h Gutta-percha, fine	per lb.	5/3 to 6/6	..
h India-rubber, Para fine	per lb.	4/6½	1¾d. dec.
i Iron, Charcoal Sheets	per ton	£18	..
i " Pig (Cleveland warrants)	per ton	58/11	11/ dec.
i " Forgings, according to size	per ton	From £11	..
i " Scrap, heavy	per ton	47/6 to 50/-	..
i " Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£21 2 6 to £21 5	10/ inc.
g " " Sheet	per ton	£21 10	10/ inc.
m Manganin Wire No. 28	per lb.	8/	..
g Mercury	per bot.	£7	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d " " " medium	per lb.	2/6 to 4/-	..
d " " " large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/4½ to 1/6½	..
p " rolled bars & rods	per lb.	1/5½ to 1/6½	..
p " " strip & sheet	per lb.	1/6 to 1/10	..
o Platinum	per oz.	100/	..
e Silicium Bronze Wire	per lb.	1/3½	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
" " in bars		£15 to £40	..
g Tin, Block (English)	per ton	£188 to £189	£5 dec.
n " Wire, Nos. 1 to 16	per lb.	2/3½	..
p White Anti-friction Metals—			
"White Ant" brand	per ton	£56 to £80	..
k Zinc, Sh's (Vieille Montagne bnd.)	per ton	£30 10	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Pulford Bros., Ltd.—We are informed that the ninth annual meeting of shareholders of this company was held at the offices of Mr. Theo. S. Sheard, chartered accountant, Liverpool, on 6th inst. Mr. Egerton G. Pulford was elected chairman, and reported that the year's trading had again been most successful, and that, owing to the expansion of the business, the directors had taken in the adjoining building. It was resolved that a dividend of 25 per cent., free of income-tax, be paid for the year ended March 31st last, and that the balance of profit be carried to reserve fund. Mr. Theo. S. Sheard was unanimously re-elected auditor.

Western Telegraph Co., Ltd.—The directors have declared an interim dividend, payable on June 24th, of 3s. per share, or at the rate of 6 per cent. per annum, free of income tax, for the quarter ended March 31st.

STOCKS AND SHARES.

Tuesday Evening.

Not much has happened during the past week to relieve the situation in the City of its unpleasant tendency to gloom. Certainly Home Rails are better, which is something for a good many people to be grateful about, and the weather, which exercises a subtle influence upon Stock Exchange prices, has undergone a change in the right direction. Confidence is, perhaps, crawling back, but there have been so many upsets of late that no surprise can be felt at the City being sceptical of much improvement taking place in the Stock Exchange until the obviously weak accounts get into more permanent hands.

In electrical railway stocks there has been no quotable change. There are buyers about, however, and that is somewhat unusual. Districts again fell to 10, and Metropolitan Consolidated went to 37½, from which there have been recoveries to 11 and 38 respectively. Underground Electric Railways Profit Notes are still weak at 71½, from which quotation it would appear as though the prospect of the Notes' redemption at par were not immediate.

British Electric Tractions failed to maintain their rise for long. The Ordinary broke from 3½ to 2⅞, but recovered to 3⅛, a drop of 7s. 6d., and the Preference exhibit a loss of the same amount at 7⅛. The First Debenture stock is a point lower. Westinghouse Debenture at 65 has fallen 1, and Brush First Debenture lost a like amount.

Activity in Argentine tramways shares has been stimulated by the nebulous rumours of certain companies being taken over, or bought out. The Belgian Syndicate report is now stretched to cover the Buenos Ayres and Belgrano Company, as well as the Anglo-Argentine Tramways. The Ordinary shares of the latter relapsed at the end of last week, but were quickly reinstated at 8⅛. Belgrano Ordinary improved to 3⅞, and are still tipped in some quarters for a 10s. rise.

Metropolitan Electric Tramways Deferred are a few pence better at 2s. 6d. For a long shot, there may be worse speculations than these. Dublin United Trams are unchanged, and those who hoped great things from the exhibition in the Irish capital are, it is declared, modifying their bullish anticipations. In fact, some say that the Exhibition, so far, has proved a failure.

Supply shares are only noticeable for declines in the prices of Charing Cross, City of London, and South London, all Ordinary shares. In spite of the severe lopping to which the County Council's Electricity Bill has been subjected by the new Spring Gardeners, there remains some doubt in the minds of proprietors of lighting shares as to how far their securities may be affected. Central Electric and Folkestone Debenture stocks both hardened, but Chelsea Debenture gave way a point.

The manufacturing group is dullish. Bruce Peebles Preference fell 5s. to 4s., and Telegraph Constructions to 31. British Insulated Ordinary dropped to 6½, business being marked at 6 7/16. Castner-Kellner shares dropped to 1 3/16, but Cromptons, after a slight fall, rallied to their previous price of 1 5/16. General Electric Preference at 8¾ were down.

The Electric and General Investment has declared a dividend of 4s. 6d., equal to 22½ per cent. on its Ordinary shares and £25 per share on the Founders' shares.

Little has happened to relieve the Telegraph and Telephone list of monotonous immobility. Telephone issues are all unmoved. Anglo-American Telegraph Deferred rose to 20 because American Rails have been a better market, but Direct United States shares are rather lower, and the fall in Eastern Extensions is continued, lowering the price to 13½. Commercial Cable Debenture stock is rather easier.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—The *Financial Times* says that a circular has been issued to the holders of debentures and shares, stating that, in view of the completion of the Normanton, Castleford and Pontefract section of the line, and for the purpose of paying the balance due to the contractors, the company require to raise for a time a sum of about £30,000. The board anticipates being able to arrange this at the rate of 6 per cent. per annum, they or some of them proposing to lend a part of it. The board considers that this plan is more to the advantage of the company than an increase of the present long-term debenture stock.

France.—La Société d'Electro-Metallurgie de Bives reports a profit of £62,286 for the last financial year. A dividend of 17½ fr. per share has been declared, and £2,941 placed to reserve.

De Mello Brazilian Rubber Co.—It is stated that the fixed dividend at the rate of 7 per cent. per annum will be paid on the participating preference shares on July 1st for the half-year ending June 30th.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Shares. †	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations June 4th.	Closing Quotations June 11th.	Business done week ended June 11th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
35,000	Amazon Telegraph Co.'s shares, Nos. 1 to 35,000	10	Nil	Nil	Nil	..	8 — 8½	8 — 8½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,360 Red.	100	Nil	Nil	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11
660,660	Anglo-American Telegraph	Stock	6½.	2½%	3½%	3½%	61½ — 64½	61½ — 64½	61⅝	..	..	6 0 2
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	6½%	6 %	6 %	107 —108	107½ —108½	108	107½	+ ½	5 10 10
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	1%	1½%	19½ — 19¾	19½ — 20½	19 15/16	19 7/16	+ ½	8 12 10
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	99 —101	99 —101	..	..	..	4 19 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
2,097,680	Commercial Cable Sing. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	92¼ — 94½	92 — 94	93½	93	— ½	4 5 1
15,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	7⅜ — 8⅛	7⅜ — 8⅛	..	..	..	6 1 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15⅜ — 16⅜	15⅜ — 16⅜	..	..	..	5 19 5
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅜ — 9⅛	8⅜ — 9⅛	8⅝	..	..	5 8 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,710	Direct United States Cable	20	8 %	8½%	4½%	..	15½ — 16	15½ — 15⅞	15⅞	..	— ⅛	5 7 11
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	101	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	137 —142	137 —142	139½	138½	..	4 18 7
2,000,000	Do. 5½ % Pref. Stock	100	5½%	5½%	5½%	5½%	89 — 91	89 — 91	90	..	..	3 16 11
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	104½—106½	104½—106½	105	104½	..	3 15 2
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13⅞ — 14	13⅞ — 13⅝ xd	13⅞	13¾	..	5 1 10
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	104½—106½	104½—106½	..	..	..	3 15 2
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	98 —101	99¼	..	..	3 19 3
230,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
131,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	5½%	10⅞ — 11⅛	11 — 11⅛	11	10⅞	+ ⅛	4 15 8
131,127	Do. do. 6 % Pref	10	6 %	6 %	6 %	6 %	13⅞ — 14⅛	13⅞ — 14⅛	13 15/16	13⅞	..	4 3 6
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	24%	20 %	84 — 86	84 — 86	..	..	..	5 11 1
88,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100—102	..	..	..	4 8 3
17,0 0	Indo-European Telegraph	25	10 %	18 %	13 %	13 %	56 — 58	56 — 58	..	..	..	5 12 1
$41,380,400	Mackay Companies Common	$100	..	..	..	..	71 — 3	71 — 8	..	..	..	..
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	..	..	..	69 — 71	69 — 71	..	..	..	..
206,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞ — ¼	⅞ — ¼	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	4 %	5 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞ — 1	⅞ — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	108 —110	109½	108½	..	5 9 1
2,225 000	Do. do. Def. Stock	100	5 %	5 %	5 %	5½%	105 —107	105 —107	106½	105½	..	5 2 10
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11½ — 12½	11½ — 12½	11 15/32	..	..	4 8 11
15,000	Do. do. 6 % Cum. 2nd Pref	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	..	..	..	4 3 4
260,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 5/16 — 5 7/16	5 5/16 — 5 7/16	5⅜	5⅜	..	4 9 11
2,000,000	Do. do. 5½ % Deb. Stock Red. ..	Stock	5½%	5½%	5½%	5½%	96½ — 97½	96½ — 97½	..	..	..	3 11 10
1,398,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101⅞	100⅜	..	3 18 5
179,818	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6¾%	6¾%	7½%	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	2d/d	..	..	5 4 4
50,000	Do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1½ — 1¾	1½ — 1¾	..	..	..	4 16 0
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 8½	7½ — 8½ xd	..	..	..	4 14 1
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	4½%	4½%	99 —102	99 —102	..	..	..	4 8 8
3,167	Submarine Cables Trust	Cer	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
80,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	105½ —111½	108½ —111½	..	..	..	4 9 8
15,609‡	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10⅜	10 — 10⅜ xd	..	..	..	3 16 2
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2	Nil	Nil	Nil	2½%	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13⅝ — 14⅜	13⅞ — 14⅜	14 7/32	14	..	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..	3 16 2
88,931	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
54,568	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	8 %	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	10 0 6
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6½ — 7½	6½ — 7½	..	..	..	Ni
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1

‡ Including arrears

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

0,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007		..	8 %	8 %	8 %	7⅞ — 8⅛	7⅞ — 8⅛	8¼	7⅞	..	4 15 6
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	5⅝ — 6	5⅝ — 6	5⅞	5⅝	..	4 11 8
266,800	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	133 —136	133 —136	..	..	..	4 8 3
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —107	104 —107	..	..	..	4 13 6
880,000	Babcock & Wilcox, 1 to 880,000	1	17 %	20 %	20 %	20 %	3⅜ — 4	3⅜ — 4	73/4⅛	76/10½	..	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	3 15 7
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	..	5⅛ — 5⅜	5⅛ — 5⅜	5 1/16	..	..	6 1 9
40,000	Do. do. 7 % Cum. Pref...	5	Nil	7 %	7 %	..	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	5 14 3
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	5 4 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	..	4 — 4¼	4 — 4¼	..	..	..	4 8 11
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	98 —101	98 —101	99	..	..	5 8 11
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	6 %	123 —127	123 —127	124½	124	..	4 14 6
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	103½ —108½ xd	103½ —108½	106½	..	..	4 12 2
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	102 —106	102 —106	..	..	..	4 14 4
288,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102½—104½	102½—104½	..	..	..	4 6 2
188,301	British Electric Traction	10	6 %	6 %	3 %	..	3½ — 3⅝	2⅞ — 3⅛	72/6	66/3	—	8 17 9
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	7⅛ — 7⅜	6⅞ — 7⅛	7⅛	6 13/16	—	8 2 9
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	101 —105	101 —104	103	100	—1	4 16 2
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	..	79 — 82 xd	79 — 82	80½	..	..	5 9 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6½ — 7	6¾ — 6⅞	6 7/16	..	— ⅛	7 8 2
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6¼	5⅞ — 6¼	6⅛	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	92 — 96	92 — 96	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
1,016,853	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	64 — 68	63 — 67	..	..	—1	5 19 5
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅞ — 1⅛	⅞ — 1⅛	..	..	..	Nil
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	2½%	Nil	⅛ — ¾	⅛ — ¾	..	..	..	Nil
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	¾ — 1⅛	¾ — 1⅛	..	..	..	Nil
195,000‡	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	89 — 92	88 — 91	88¼	77/6	—1	4 18 11
125,000‡	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	75 — 78	75 — 78	..	..	..	5 15 5
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	3½ — 4	3⅜ — 4⅛	78/1½	73/9	+ ⅛	3 12 9
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜ — 5⅜ xd	4⅜ — 5⅜	..	..	..	5 17 1
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜ — 5⅜ xd	4⅜ — 5⅜	..	..	..	5 14 3
13,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
100,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
137,610	Calcutta Trams., 1 to 137,610	5	6 %	8 %	8 %	8 %	7⅛ — 8 xd	7⅛ — 8	7 11/16	7⅝	..	5 0 0
80,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	..	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 6 11
850,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	105 —108	104 —107	105½	105	—1	4 4 1
85,000	Callender's Cable Construction shares	5	12½%	12½%	15%	15 %	10 — 11	10 — 11	..	..	..	6 16 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	5 1/16	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106½—108½	106½—108½	..	..	..	4 2 11
491,229	Cape E. Trams., 1 to 491,229	1	10 %	5 %	Nil	..	⅜ — ½	⅜ — ½	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1 1/16 — 1 1/8 xd	1⅛ — 1⅛	24/3	..	— 1/16	6 8 0
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	70 — 72	70 — 72	71	70⅝	..	5 11 1
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	93½	..	..	4 5 1
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	53 — 56	53 — 56	..	..	..	7 2 10
1,480,000	City and South London Railway	Stock	2½%	2½%	1⅞%	2½%	40 — 42	41 — 43	42	40⅞	+1	4 18 10
85,000	Crompton & Co., Nos. 1 to 85,000	5	2½%	2½%	2½%	..	1½ — 2 1/16	1½ — 2 1/16	..	..	..	3 14 0
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..	5 1 6

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated, all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(Continued.)*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations June 4th.	Closing Quotations June 11th.	Business done week ended June 11th, 1907.		Rise + or Fall —	Present Yield per cent
		†	1903.	1904.	1905.	1906.			Highest.	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1 15/32 — 1 17/32	1 15/32 — 1 17/32	..	..	..	7 16 10
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000 ..	1	6 %	6 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	102 —105	102 —105	..	..	..	4 5 9
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½ %	6 %	6 %	..	13½ — 14½	13½ — 14½	..	..	..	4 2 9
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	13 — 14	13 — 14	..	..	..	4 9 3
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	5	Nil	2½ %	4½ %	..	1 — 1⅛	1 — 1⅛	..	..	..	10 0 0
17,189	Do. "A" shares, 01—017,189 ..	5	Nil	2½ %	4½ %	..	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	89 — 92	..	..	..	5 8 8
112,100	Electric Construction 1 to 112,100	2	4 %	Nil	Nil	..	⅛ — 7/16	⅛ — 7/16	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1⅛ — 2	1⅛ — 2	..	..	..	7 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref. ..	10	4 %	5 %	5 %	5 %	8¼ — 9⅛	8¼ — 9	..	..	— ⅛	5 11 1
200,000	Do. do. 4 % Mort. Deb. ..	Stock	4 %	4 %	4 %	4 %	92 — 95	92 — 95	..	..	..	4 4 3
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	3 %	4 %	4 %	4 %	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..	14 10 10
96,000	Greenwood & Batley 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10⅛ — 10⅜	10⅛ — 10⅜	..	..	..	6 18 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11⅜ — 12⅜	11⅜ — 12⅜	..	..	..	5 17 8
200,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	3 15 7
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	105 —107 xd	105 —107 xd	..	..	..	4 4 1
60,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10%	5 %	10%	10 %	15 — 16	15 — 16	..	..	..	6 5 0
87,500	†Liverpool Overhead Railway, Ord.	10	12½	12½	Nil	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
10,000	† Do. do. Pref. £10 paid ..	10	5 %	5 %	5 %	5 %	6 — 7	6⅛ — 7⅛	..	..	+ ⅛	6 13 4
600,070	London United Trams (1901), 1 to 60,007	10	8 %	6 %	8 %	8 %	8⅛ — 8⅜	8⅛ — 8⅜	..	..	..	8 8 7
899,980	Do. do. 60,008 to 100,000	10	8 %	6 %	8 %	8 %	7 — 7⅛	7 — 7⅛	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000 ..	10	5 %	5 %	5 %	5 %	7⅛ — 8⅛	7⅛ — 8⅛	8⅛	..	..	5 14 3
1,931,000	Do. do. 4 % 1st Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	84 — 88	84 — 88	86	85⅝	..	4 10 11
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	Nil	3/16 — 5/16	3/16 — 5/16	2/-	..	..	Nil
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	27/32 — 29/32	27/32 — 29/32	17/6	..	..	5 8 11
850,000	Do. 4½ % Deb. Stock Red.	100	..	4½ %	4½ %	4½ %	96 — 99	96 — 99	..	..	..	4 10 11
30,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	4 — 4⅛ xd	3½ — 4½	..	..	— ½	7 1 2
245,500	Potteries E. Tro.	1	5 %	5 %	4 %	4 %	3/16 — 5/16	3/16 — 5/16	..	..	..	6 8 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 3/16	1/16 — 3/16	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	96½ — 99½ xd	95 — 98	..	..	—1½	4 11 10
87,850	Telegraph Construction and Maintenance ..	12	20 %	15 %	15 %	15 %	80½ — 82½	80 — 82	80½	..	— ½	5 13 2
150,000‖	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..	3 16 11
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts. ..	..	..	5 %	5 %	5 %	70 — 73 xd	70 — 73	70½	..	..	6 17 5
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1⅛ — 1⅜	1⅛ — 1⅜	27/6	..	..	Nil
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3½ — 4½	3½ — 4½	..	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	78 — 82	78 — 82	..	..	..	4 17 7

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5½%	5½%	5½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 4 9
70,000	Do. do. 4½ % 1st. deb. stock ..	100	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..	4 10 11
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	8 — 9	8 — 9	..	..	..	5 11 1
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	..	4 2 4
836,876	Central Electric Supply 4 % Guar. Deb. Stock ..	100	4 %	4 %	4 %	4 %	98 —101 xd	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply ..	5	8 %	8 %	5 %	5 %	3⅝ — 4⅛	3 — 4	..	..	— ½	6 5 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅝ — 4⅛	3⅝ — 4⅛	..	..	..	5 5 11
427,400	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	98½	..	..	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	5½ %	6 %	6 %	4½%	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	4 14 9
175,000‖	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —107	103 —106	104⅜	..	—1	4 4 11
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9⅜ — 10⅜	9½ — 10⅜	9 1/16	..	— ⅜	5 17 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅜ — 12⅛	11⅜ — 12⅛	11⅜	..	..	4 18 0
400,000‖	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..	3 19 4
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	97 —100	97 —100	99½	98⅝	..	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	4 %	£8 7 0	4 %	4 %	4⅛ — 5	4⅛ — 5	..	..	..	4 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅛ — 5	4⅛ — 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	7⅜ — 8⅛	7⅜ — 8⅛	7 23/32	7 25/32	..	5 17 8
40,000	Do. do. 6 % Pref., 40,001—80,000	10	6 %	6 %	6 %	6 %	10½ — 11⅛	10½ — 11⅛	11 1/16	11 3/16	..	5 4 4
400,000‖	Do. do. 4½ % Deb. Stock ..	..	4½%	4½%	4½%	4½%	106 —109	106 —109	107	..	..	4 2 7
400,000	Do. do. 4½ % 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	94 — 97	94 — 97	95	94½	..	4 12 9
80,000	Edmundson's Electric Corporation, Ord. Shares ..	5	7 %	7 %	4 %	..	⅛ — 1⅛	⅛ — 1⅛	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref... ..	5	6 %	6 %	6 %	6 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	12 0 0
850,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	78 — 83	78 — 83	..	..	..	5 0 0
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅞ — 5⅜ xd	4⅞ — 5⅜	..	..	..	5 8 5
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 15 8
90,000	Do. 4½ % 1st. Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	98 —101	..	..	+1	4 9 1
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	7 — 7⅛ xd	7 — 7⅛	..	..	..	6 0 0
21,000	Kensington and Knightsbridge Electric Ord. ..	5	12½	12½	10 %	10 %	8⅜ — 9⅛	8⅜ — 9⅛	..	..	..	5 0 0
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
111,000	London Electric Supply Corporation, Limited, Ord.	5	Nil	3 %	4 %	4 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	5 6 8
70,000	Do. do. do. 6 % Pref...	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 14 3
674,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	95 — 98	95 — 98	..	..	..	4 11 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½%	10 %	10 %	8 %	5⅜ — 6⅜	5⅜ — 6⅜	6¼	5 15/16	..	6 8 0
76,121	Do. 4½ % Cum. Pref. 1—71,106 ..	5	4½%	4½%	4½%	4½%	4⅛ — 5⅛	4⅛ — 5⅛	..	..	..	4 8 9
220,000‖	Do. 4½ % 1st Mort. Deben. Stock ..	..	4½%	4½%	4½%	4½%	105 —109	105 —109	..	..	..	4 2 7
250,000‖	Do. 3¾ % Mort. Deben. Stock Redem.	Stock	3¾%	3¾%	3¾%	3¾%	88 — 93	88 — 93	..	..	..	3 16 3
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	7⅛ — 7⅞	7⅛ — 7⅞	..	..	..	5 3 3
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	5 — 6	5 — 6	..	..	..	4 3 4
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	12 — 13	12 — 13	..	..	..	5 15 5
64,000	Do. do. 4 % 1st Mort.Deb... ..	100	4 %	4 %	4 %	4 %	96 — 99	96 — 98	..	..	— ½	4 1 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	6 — 6½	6 — 6½	..	..	..	5 7 8
60,000	Do 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord. ..	5	14½%	14½%	12½%	10 %	7⅜ — 8⅛	7⅜ — 8⅛	..	..	..	5 17 8
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	4 13 4
150,000‖	Do. do. 3¾ % Deb. Stock Red. ..	100	3¾%	3¾%	3¾%	3¾%	88 — 93	88 — 93	..	..	..	3 15 3
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	1½ — 2½	1½ — 2½	..	..	..	Nil
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..	5 3 11
65,000	South London Electricity Supply, Ord.	5	8 %	4 %	4 %	3 %	2⅛ — 2⅜	2 — 2⅛	42/6	..	— ⅛	6 0 0
120,000	South Met. Elec. Lt. & Power, Ord..	1	Nil	Nil	2½%	2½%	3/16 — 5/16	3/16 — 5/16	..	..	..	3 6 8
117,968	Do. Do. 7 % Pref... ..	7	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 10
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	10 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..	7 2 10
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
110,000	Westminster Electric Supply, Ord.	5	19½%	14 %	18 %	12 %	9 — 10	9 — 10	9 5/16	..	..	6 0 0
81,279	Do. do. 4½ % Cum. Pref. .. (Original 5%— Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	5 %	4¼%	5⅛ — 5⅜	5 3/16	5⅛	..	3 18 8

Unless otherwise stated all shares are fully paid. ‖ Interim dividends.

Bank rate of discount 4 per cent. April 25th, 1907.

HOW TO KEEP PROMISES OF DELIVERY.

By J. STRATTON, M.I.Mech.E., of Messrs. W. T. Glover & Co., Ltd.

To most managers of works, the keeping of promises of delivery, made either by themselves or their assistants, presents one of the greatest difficulties they have to contend with. This, not because the actual work takes longer to do than was anticipated, nor because the men concerned in the handling of the work are unwilling to give these orders preference, but simply because of the difficulties which present themselves to the ordinary works foreman in attempting to follow through the works a number of orders which have been promised, each one, perhaps, having to pass through a dozen or more processes.

Few realise how little time is actually spent on manufacturing an article, compared with the total time which elapses between a customer's placing an order and receiving the goods.

Take, for instance, an order for which a delivery of two months has been promised.

Here we have a total of, say, 400 working hours in which to execute the work. Out of this total of 400 hours, it will probably be found, after the job has been completed, that 150 hours was spent on the actual manufacture, the remaining 250 hours being taken up either in passing the work from one department to another and awaiting its "turn" therein, or in various ways, other than actually doing the work.

It must be remembered that we are not dealing here with the question of reducing the time of manufacture to lower the cost, but simply with the question of quick delivery to the customer, and while, perhaps, 10 or even 20 per cent. of the time taken in manufacture can be saved by judicious supervision, 60 or 80 per cent. of the time wasted in passing the job from one department to another, and letting it await its "turn," can be saved by close attention and suitable remedies.

Usually promises are asked for and dealt with as follows:—

A customer requires a promise of delivery for his goods. The general office obtains a promise from the works, which is handed on to the customer. In many works a record is not kept of these promises, or, if a record is kept, there may be so many promises, and so many processes to watch, that the foremen become confused, and lose sight of one or more of the orders.

Nothing annoys your customer more, or dislocates his business more effectually, than failure to keep such promises of delivery.

A clerk may even be appointed to watch these particular orders day by day, and report progress, but he can only remind the various departmental foremen that such and such a job has not been done, or that it is not moving through the works as quickly as would appear desirable.

Again, the official who makes the promise, perhaps the manager himself (using his experience), will simply state the time when he thinks the job will be *completed*, and obviously, unless he has each particular order that has been promised watched through each particular process, keeping every man up to the mark *day by day*, he cannot guarantee that the work will be completed in the time he has stated.

Here, then, we see the need of some system which is at once automatic, and of such a nature that while it will not increase the cost, it will keep these specially urgent orders constantly before the notice of every man who is concerned in the execution of them.

Below are given details of a system which we have recently adopted, and which we have found highly successful; so much so, that not only have we been able to dispense with the services of a clerk (whose special duty it was to look after these promises), but since the system was first instituted a few months ago, the works have not had one serious complaint of a promise not having been kept; and while no system of ensuring the fulfilment of promises will prevent accidents, we are able by this new method to advise our customer immediately if an accident has happened to his order, and so to give him the minimum annoyance, and secure his confidence in his work having the best attention we can give it.

In dealing with our orders in the works, a separate *ticket* or label (fig. 1), containing full details of manufacture, is printed and attached to every single length of wire or cable, no matter how small, from the moment it is commenced in the works.

A duplicate of each of these *tickets* is printed on a white *card* (fig. 2) and sent with the tickets (fig. 1) to the department in which the cable is first commenced.

The *tickets* are attached to the *cables*; the *cards* constitute the advice from one department to another, and are filed in pigeon holes therein provided for the purpose, 31 in number, *i.e.*, one for each day in the month.

These pigeon holes are fixed in a prominent position in each department, so that it is possible for anyone to see how many orders were received on any given date in any department, and the foremen are enabled to keep in close touch with every order.

The backs of the white cards are ruled (fig. 2A). A special rubber stamp is provided in each department, with which each card is stamped at the back with the date when received and the name of the department (fig. 2A).

Should a customer require a promise for the whole of his order, which may consist of, say, 20 lengths of cable, to each of the white cards is attached by means of a gummed tape a "red" card headed "Promise of Delivery" (fig. 3).

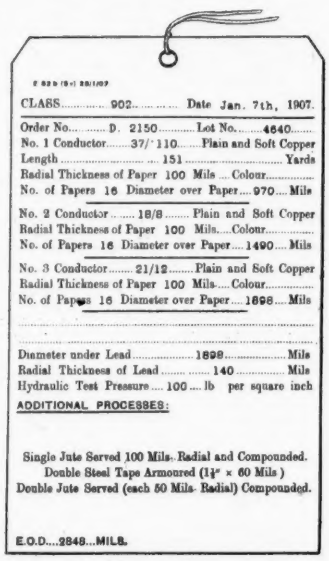
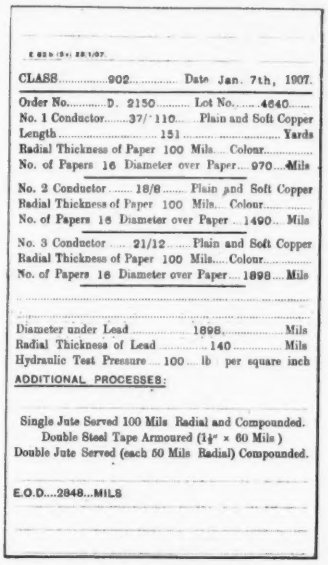

CLASS 902 Date Jan. 7th, 1907.
Order No. D. 2150 Lot No. 4640
No. 1 Conductor 37/·110 Plain and Soft Copper
Length 151 Yards
Radial Thickness of Paper 100 Mils Colour
No. of Papers 16 Diameter over Paper 970 Mils
No. 2 Conductor 18/8 Plain and Soft Copper
Radial Thickness of Paper 100 Mils Colour
No. of Papers 16 Diameter over Paper 1490 Mils
No. 3 Conductor 21/12 Plain and Soft Copper
Radial Thickness of Paper 100 Mils Colour
No. of Papers 16 Diameter over Paper 1898 Mils
Diameter under Lead 1898 Mils
Radial Thickness of Lead 140 Mils
Hydraulic Test Pressure 100 lb per square inch
ADDITIONAL PROCESSES:
Single Jute Served 100 Mils Radial and Compounded.
Double Steel Tape Armoured (1¼" × 60 Mils)
Double Jute Served (each 50 Mils Radial) Compounded.
E.O.D....2848...MILS.

FIG. 1.—LABEL.


CLASS 902 Date Jan. 7th, 1907.
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Radial Thickness of Paper 100 Mils Colour
No. of Papers 16 Diameter over Paper 1490 Mils
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Radial Thickness of Paper 100 Mils Colour
No. of Papers 16 Diameter over Paper 1898 Mils
Diameter under Lead 1898 Mils
Radial Thickness of Lead 140 Mils
Hydraulic Test Pressure 100 lb per square inch
ADDITIONAL PROCESSES:
Single Jute Served 100 Mils Radial and Compounded.
Double Steel Tape Armoured (1¼" × 60 Mils)
Double Jute Served (each 50 Mils Radial) Compounded.
E.O.D....2848...MILS

FIG. 2.—FRONT OF CARD.

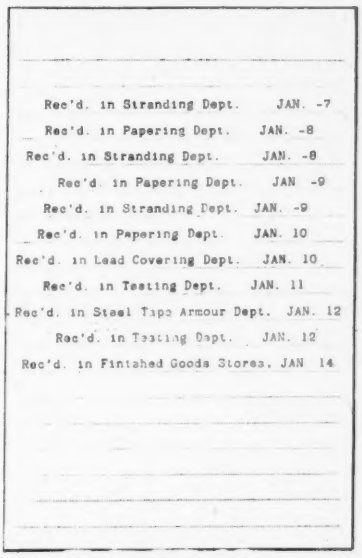
Rec'd. in Stranding Dept. JAN. -7
Rec'd. in Papering Dept. JAN. -8
Rec'd. in Stranding Dept. JAN. -8
Rec'd. in Papering Dept. JAN -9
Rec'd. in Stranding Dept. JAN. -9
Rec'd. in Papering Dept. JAN. 10
Rec'd. in Lead Covering Dept. JAN. 10
Rec'd. in Testing Dept. JAN. 11
Rec'd. in Steel Tape Armour Dept. JAN. 12
Rec'd. in Testing Dept. JAN. 12
Rec'd. in Finished Goods Stores. JAN 14

FIG. 2A.—BACK OF CARD.

On this red card is stamped not only the date when each length of cable should be received in the Finished Goods Stores ready for despatch, but also the date when it should be received in each of the various departments through which it progresses in course of manufacture.

Once a promise has been made for an order, the date on which it is received in any department must correspond exactly with the date stated on the red promise card.

The method of fastening the red card to the white card allows them to open like the covers of a book, so that the dates on which a cable should be received in the various departments, and the dates on which it is actually received there, appear side by side (fig. 4).

The whole of the cards for "promised" orders are collected every morning and examined in the Works Manager's Office to see if the dates on the "promise" cards are adhered to.

If any single length has dropped behind, the foreman responsible is required to give an explanation, and the time must be picked up in the next department; but so well does the system work that this course is seldom necessary, as it is such a simple matter for the foreman to take out the cards which have been promised (these are easily distinguished by the red cards attached), and see that these jobs are given preference.

The key to the whole system may be kept in the Manager's Office. This consists of an upright case, containing a number of small partitions or slots (fig. 5). A certain number of these small partitions are allocated to each day of the month, the number depending upon the amount of promises required to be given each day.

When an order is promised for completion (similar to that above described consisting of 20 lengths), *one* small blue ticket (fig. 6) is made out, stating simply the order number, and the date on which it should be delivered into the Finished Goods Stores. The manager himself can then see at a glance if promises are being kept, as these small tickets are removed from the file daily as the orders are passed into the stores.

Should an accident, or some other unforeseen circumstance, happen to delay an order, a second promise is made, for which a red ticket (fig. 7) is used, signifying that it is the second promise.

While we apply the above system to cable manufacture, it is possible to apply it to any other article, and not only does it ensure a promise being kept, but it teaches the man

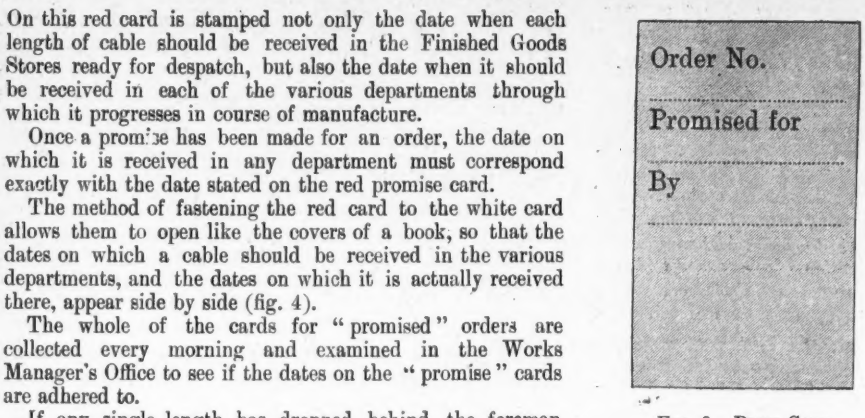

FIG. 6.—BLUE CARD. FIG. 7.—RED CARD.

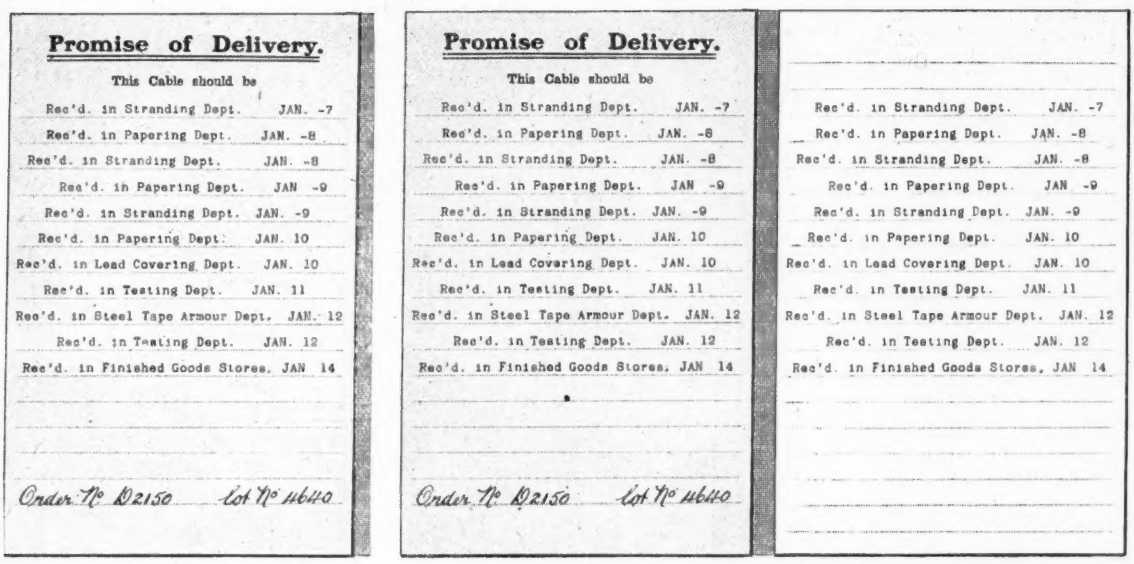
Promise of Delivery.
This Cable should be
Rec'd. in Stranding Dept. JAN. -7
Rec'd. in Papering Dept. JAN. -8
Rec'd. in Stranding Dept. JAN. -8
Rec'd. in Papering Dept. JAN -9
Rec'd. in Stranding Dept. JAN. -9
Rec'd. in Papering Dept. JAN. 10
Rec'd. in Lead Covering Dept. JAN. 10
Rec'd. in Testing Dept. JAN. 11
Rec'd. in Steel Tape Armour Dept. JAN. 12
Rec'd. in Testing Dept. JAN. 12
Rec'd. in Finished Goods Stores. JAN 14
Order No D2150 Lot No 11640
Promise of Delivery.
This Cable should be
Rec'd. in Stranding Dept. JAN. -7
Rec'd. in Papering Dept. JAN. -8
Rec'd. in Stranding Dept. JAN. -8
Rec'd. in Papering Dept. JAN -9
Rec'd. in Stranding Dept. JAN. -9
Rec'd. in Papering Dept. JAN. 10
Rec'd. in Lead Covering Dept. JAN. 10
Rec'd. in Testing Dept. JAN. 11
Rec'd. in Steel Tape Armour Dept. JAN. 12
Rec'd. in Testing Dept. JAN. 12
Rec'd. in Finished Goods Stores. JAN 14
Order No D2150 Lot No 11640
Rec'd. in Stranding Dept. JAN. -7
Rec'd. in Papering Dept. JAN. -8
Rec'd. in Stranding Dept. JAN. -8
Rec'd. in Papering Dept. JAN -9
Rec'd. in Stranding Dept. JAN. -9
Rec'd. in Papering Dept. JAN. 10
Rec'd. in Lead Covering Dept. JAN. 10
Rec'd. in Testing Dept. JAN. 11
Rec'd. in Steel Tape Armour Dept. JAN. 12
Rec'd. in Testing Dept. JAN. 12
Rec'd. in Finished Goods Stores. JAN 14

FIG. 3.—RED CARD WITH GUMMED TAPE. FIG. 4.—RED CARD JOINED TO WHITE CARD.

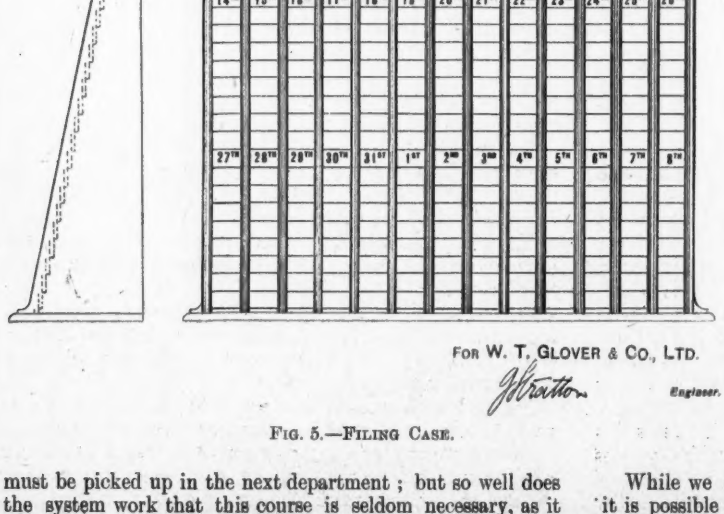

FIG. 5.—FILING CASE.

who is appointed to make the promise of delivery exactly how long each job takes in each department; as his instructions are always to err on the side of quick delivery rather than otherwise, it may be taken for granted that each foreman will soon let him, or the manager, know if a promise has been made which it is impossible to keep, and the cards can also be used afterwards as a record for future guidance.

There is only one word of warning to be added in conclusion, viz., see that the system is not abused, and do not under any consideration ask your works to make too many promises, as otherwise you will simply increase, rather than decrease, the difficulties of the foremen.

IMPROVEMENTS IN PROJECTORS.—II.

By JOHN I. HALL.

The question of searchlights has not received much attention of late in the technical Press, probably because it is commonly supposed, as they have been so long on the market, and there are so few parts about them to require attention, that the last word has been said long ago, and there is not room for improvement.

But, in the opinion of the writer, there is considerable room for modification, particularly in connection with the flashing gear, as it is in this detail of design that defects still exist, and many projectors if critically examined would be found to have defects in the projected beam, which would certainly give the impression that very little attention had been given to the question of efficiency by the designers.

In the design of flashing gear, one principle should always be strictly maintained—viz., that no object should on any account be fixed within the cone of direct rays, formed by the mirror as the base, and the arc of the lamp as the apex

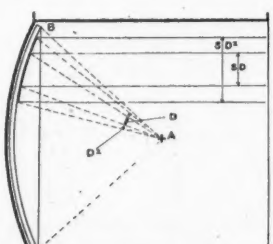

Fig. 1.

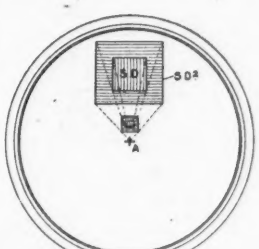

Fig. 2.

of the cone. This is the vital part of the projector, and if any object is placed within this cone, it impairs, in a two-fold manner, the efficiency of the reflected beam, first by casting a shadow on the mirror, and again by the shadow of the object in the beam; but the shadow cast on the mirror is generally the most serious. This will be understood by reference to fig. 1.

If an object D is placed between the arc and the mirror, and within the angle A B C—that is, within the cone of direct rays—a shadow is cast on the mirror B C. The extent of the shadow depends upon the position and size of D.

In designing flashing gear it is a rule to keep it as small as possible, and therefore it is put as close to the arc as convenient. If an object, D, is placed one quarter the distance from A, then it will cast a shadow on the mirror 16 times its own area. If D be 1 in. square, the shadow cast on the mirror will be 16 in. in superficial area, equal to 3·5 per cent. of the total area of a projector 24 in. in diameter, or 5 per cent. of one 20 in. in diameter. That may not seem to contribute a very serious defect, but make D^2 2 in. square, the shadow cast on the mirror will then be 64 in. in area. Thus, 14 per cent. of the illuminating power of a 24-in., and 20 per cent. of a 20-in. one, would be lost, as indicated by S D and S D^2 in fig. 2.

If such a shadow occurs in the upper part of the beam, which is the most valuable part of the projected light, then it is a most serious defect.

The most obvious remark to such a criticism as the above on projector design is that no designer would do anything so foolish. I shall, however, be able to show, unfortunately, that defects as serious as those I have indicated above do actually occur in projectors, and I shall further be able to give drawings of actual shadows observed in the beams.

The attention of the writer was first directed to the subject some years ago, when a small projector was being tried in one of the shipyards on the Thames. The projector was commercially described as of 30,000 c.p. The candle-power, upon trial, was a long way below the specified illumination.

The nature of the defect is shown in fig. 3, where, instead of a clear round beam appearing, it is divided into two parts by a shadow running horizontally across the middle.

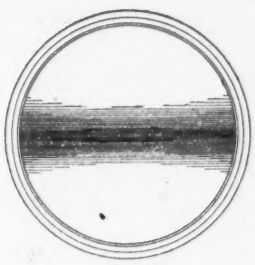

Fig. 3.

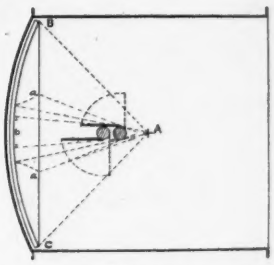

Fig. 4.

The shadow was caused by the flashing gear being fixed on spindles running through the cone of rays, as shown in fig. 4.

From this illustration, it is obvious that the nearer the spindles of the gear are to the arc, the broader the shadow will be on the mirror. The shadow is, of course, wider at the outer edges at *a*, as that part is further from the arc than the central portion of the mirror *b*.

This defect was to a great extent removed by the spindles being cut away in the middle where they passed through the cone of rays, and connected together by thin flashing plates, $\frac{1}{16}$ in. thick; when closed together they were thus only $\frac{1}{8}$ in. thick instead of about $\frac{3}{4}$ in. broad, as originally designed.

Such a defect is serious enough, but others have been observed by the writer in projectors by other and responsible firms of high standing.

In larger projectors the shadows are usually confined to the upper part of the beam, just where they ought not to be, as this is the most valuable part, and should have the absolute maximum efficiency.

The most common types of flashing gear are shown in figs. 5 and 8.

They are either made of flat plates as shown in fig. 5, or concave dishes as shown in fig. 8 (p. 984). They are centred

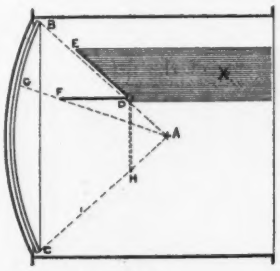

Fig. 5.

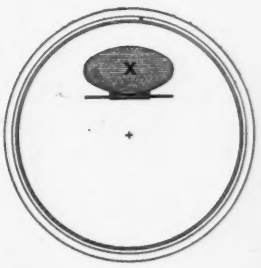

Fig. 6.

as shown at D, and are either placed at an angle to the axis of the projector, as shown by D E, or horizontally as shown by D F, fig. 5.

When not in use they are fixed in positions indicated by full lines, and when in operation in those shown by the dotted lines D H. The dotted lines D H in each case show the gear in operation.

The least objectionable of these is the one shown at D E, fig. 5. This has the merit of being responsible for only one shadow cast forward in the beam, as shown at X in the same figure, and also by X, fig. 6, which shows the extent of the shadow.

It may be argued that by refraction this shadow would be non-effective at a distance from the beam. But this cannot be, as such a shadow must cause the light to be more rarefied than it would otherwise be, and therefore less effective in illuminating power.

By way of variation, or because the operating handle only requires to be moved through 90° instead of about 130°, some designers prefer to have the flashing shutter, when not in operation, fixed as shown by D F, fig. 5.

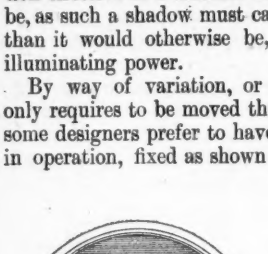

FIG. 7.

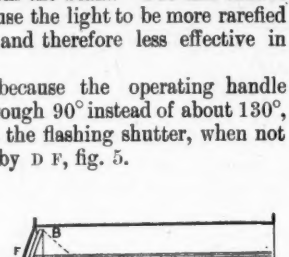

FIG. 8.

The effect of this is to cast a shadow on the mirror at G, as shown in the profile view ; the extent of the shadow is more effectively illustrated by X X in fig. 7. It is almost incredible that a projector should be so defective in illumination. They have, however, been produced and sold as the best of their kind, and the most efficient commercial articles, sound in every part, and better than those by other competitors.

Another bad example is shown in fig. 8, where a convex shutter is fixed right inside the cone of rays, apparently without any other reason than that some of the light can get over the top to the upper part of the mirror. A shadow

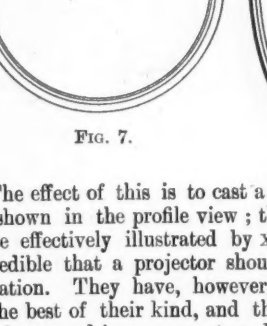

FIG. 9.

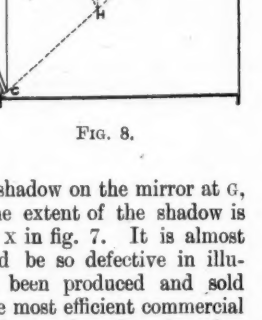

FIG. 10.

is cast on the mirror, as shown at F G, the reflected shadow is shown by X X, and the extent of the shadow in area is shown by X X in fig. 9. In addition to the reflected shadow X X, there is the direct shadow X.

I have endeavoured to show some of the defects in the flashing gear of projectors which have come under my notice, and they seem sufficiently grave to be condemned. Some may say that the arc of the lamp having a considerable area, the shadows are not so defined, and therefore not so large in area. But such conclusions are wrong, as they are very sharply outlined.

In any case, such obvious defects ought not to exist.

Now, to show definitely the serious nature of the defects as projected in the beam by badly-designed gear and defective workmanship, I will refer to figs. 10, 11 and 12. These figures are reproductions from actual shadow projections obtained by putting sheets of white paper on the front glasses of three projectors—taken indiscriminately from a batch of 12—and tracing the shadows cast thereon.

There are several observations incidental to these three drawings. Down the centre of each the shadows of the lamp rod and carbons are clearly defined

S_1 indicates the direct shadow of the flashing plates, with supports on either side.

S_2 shows the reflected shadows, which indicate those parts of the mirror which are in shade, and therefore cannot reflect any light.

S_3 shows the shadow of the direct ray obscuring disks.

S_4 shows the lamp rod and carbons.

S_5 and S_6 show the base of the lamp and an indefinite shadow round the bottom of each beam, which would indicate that the reflectors were not set correctly.

The workmanship in fitting the flashing gear is evidently most defective, particularly in figs. 11 and 12, otherwise the shadows S_2 would not vary in extent as they do.

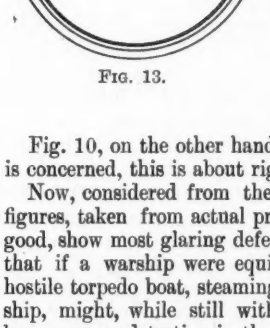

FIG. 11.

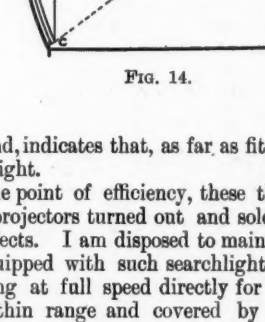

FIG. 12.

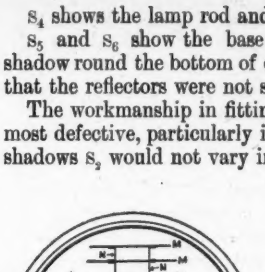

FIG. 13.

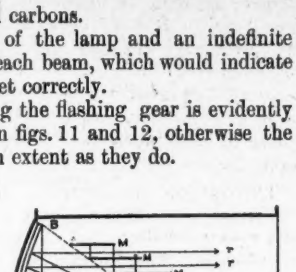

FIG. 14.

Fig. 10, on the other hand, indicates that, as far as fitting is concerned, this is about right.

Now, considered from the point of efficiency, these three figures, taken from actual projectors turned out and sold as good, show most glaring defects. I am disposed to maintain that if a warship were equipped with such searchlights, a hostile torpedo boat, steaming at full speed directly for the ship, might, while still within range and covered by the beam, escape detection in the shadows until too late to avert disaster.

From a consideration of the drawings given herewith, it is evident that there is no need for such an accumulation of shadows ; that those marked X X are entirely unnecessary, while those marked X should not be allowed if they can be avoided.

To overcome these defects, the writer designed the flashing gear shown by figs. 13 and 14.

This apparatus is constructed of a number of thin sheets of metal M, placed horizontally and secured together by channel pieces N, fig. 13, made out of thin metal sheet. To the underside of the bottom plate M, blocks are secured for

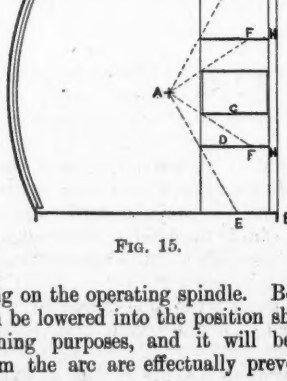

FIG. 15.

FIG. 16.

mounting on the operating spindle. Being centred at D, the gear can be lowered into the position shown by dotted lines for flashing purposes, and it will be observed that the rays from the arc are effectually prevented from reaching the mirror.

As shown in fig. 14 by full lines, this apparatus is mounted so that it does not intercept any of the light between the

arc and the mirror, which reflects a clear and full beam, as the reflected rays r pass through the plates of the gear, and the percentage of light intercepted by these thin plates is so infinitesimally small as to be negligible.

Fig. 13 is a front view of a projector fitted with this shadowless flashing gear, from which it will be seen that the breadth of any shadow from it is not more than $\frac{1}{16}$th of an inch, except where the horizontal and vertical plates are joined together.

Another source of needless obstruction, but of less importance than defective flashing gear, is the direct ray obscuring disk S_3, shown in figs. 10 to 12.

This disk is generally made as small as possible, so as just to prevent the direct light of the arc escaping from the front glass, but the whole of the inside of the barrel of the projector is under the full glare of the lamp.

No such disk, however, is necessary if the method is adopted which is illustrated in figs. 15 and 16.

This arrangement consists of two concentric cylinders C D formed of thin plates, and supported by fixing plates G secured to the projector barrel. The cylinders are parallel to the axis of the projector, the reflected rays passing through them, and no unsightly shadow is produced.

The direct rays of the arc are kept well away from the front of the projector, as shown by the lines A E and A F. The inside of the barrel from E to B, and the inner face of D from F to H is in shadow.

The small amount of light that can escape from the small cylinder C is negligible, as the lamp rods would throw a shadow sufficient to prevent any direct rays getting through.

A further advantage exists in the light of the arc being thrown back well within the inside of the projector case, and no direct light whatever escapes.

A further advantage will be secured if the outside cylinder is continued backwards, that is, towards the mirror, so that the inside of the projector case is in total shadow.

STATIC BALANCERS.

By CHARLES C. GARRARD, Ph.D., A.M.I.E.E. A.Am.I.E.E

1. *Introduction.* — The use of static balancers, or equalisers, on three-wire continuous-current systems, in order to balance the voltage between the outers and the neutral, was introduced some years ago by the Allgemeine Elektricitäts Gesellschaft, of Berlin. The system has been used also to some extent in this country. The inherent advantages of the system, such as absence of rotating parts, high efficiency and automatic action, would promise more extended application of the system in the future, especially in sub-stations and in conjunction with rotary converter and motor converter installations.

With rotary converter installations it often has been arranged that the midwire of the D.C. network is connected to the star point of the transformers supplying the rotaries. While the balancing results obtained from this form of connection have been highly satisfactory, it will be shown in this article that the scheme is a bad one from the efficiency and cost point of view. In all such systems it would be highly advisable to disconnect the neutral wire from the star point of the transformers, and to lead back the out-of-balance current into the converter *viâ* a static balancer and the slip rings.

2. *General Description of Apparatus.*—The static balancer really consists of a choke coil, the terminals of which are connected to two or more brushes bearing on slip rings connected to equally-spaced points round the armature of the dynamo. Between the slip-rings, of course, an alternating electromotive force is generated, but the strong choking action of the balancer prevents any large flow of alternating current out from the slip-rings. At a point midway between the terminals of the balancer the connection to the midwire of the D.C. network is made.

A diagram illustrating the system is given in fig. 1. D is the dynamo, shown diagrammatically as a two-pole one. In addition to the commutator, the armature is provided with slip-rings. The balancer is shown as of three-phase construction, having three legs connected in star. It, however, could be constructed single, two, three or six-phase, and the relative advantages of the number of phases will be discussed below.

3. *Regulation of Voltage of Dynamo with Static Balancer.*—Due to the passage of the out-of-balance current through the balancer and armature of the dynamo, there will

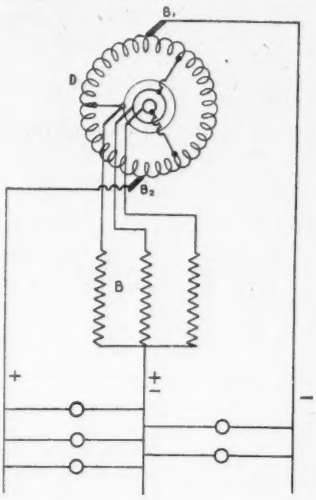

Fig. 1.

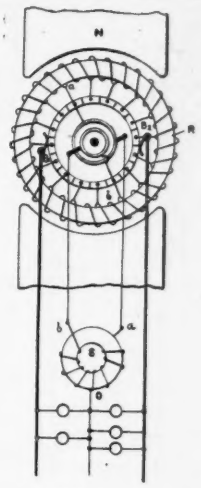

Fig. 2.

be a certain drop in volts, and to this extent the voltage on each side of the D.C. network will get out of balance. It is, of course, desired to keep this variation as small as possible. In order to see what this will amount to, we will first calculate the

(*a*) *Armature Resistance in the Path of the Out-of-Balance Current.*—We will, as before, consider a two-pole dynamo. The result obtained, however, is applicable directly to multipolar machines. Consider a certain portion of the out-of-balance current going into the armature at S (fig. 3),

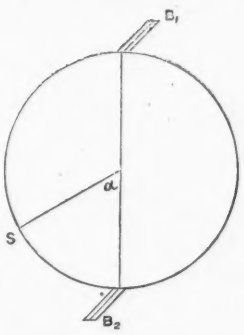

Fig. 3.

Fig. 4.

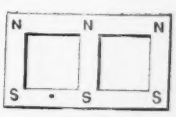

Fig. 5.

which, at a certain instant, is at an angle a relative to the more heavily loaded brush B_2. The resistance (brush to brush) of the armature winding (internal resistance of the machine) is equal to $A\frac{\pi}{2}$, where A is a constant and equal to $\frac{2R}{\pi}$, R being the internal resistance of the machine. We desire to find the average resistance r in the armature through which the current entering at S has to pass before reaching B_2. This is given by the expression

$$r = \frac{1}{2\pi}\int^{2\pi} \frac{1}{\frac{1}{A\,a} + \frac{1}{A\,(2\pi - a)}}\, d\,a = \tfrac{2}{3}\,R.$$

Thus the current entering at a slip-ring has to overcome an average armature resistance of $\frac{2}{3}$ R. It will be observed that this armature resistance is independent of whether there be two, three, or more slip-rings. The resistance in the

path of the current entering by each slip-ring is the same, the various currents being in parallel.

We are now able to calculate the drop due to the out-of-balance current. For simplicity we will consider a single-phase balancer. Let the out-of-balance current be x per cent. of the full load current of the machine. The armature resistance is R. Let the ohmic resistance of each winding of the balancer be r ohms. Now, it is obvious that the out-of-balance current C will divide itself equally between the two coils of the balancer, as these are quite symmetrical as regards each other, both inside and outside the armature. It is also clear that the direct current in each coil of the balancer will be a steady one, otherwise the induction of the balancer would oppose a large impedance to the flow back of the out-of-balance current. Therefore, if we find the drop due to the out-of-balance current flowing from the mid-wire *viâ* one coil of the balancer to B_2, we shall find the whole drop due to the out-of-balance current. This drop is $\frac{C}{2}\left\{r + \frac{2}{3}R\right\}$, and is the amount by which the voltage between the neutral and the more heavily loaded side will exceed the voltage between the neutral and the lightly-loaded side. To take a concrete example, let the voltage between outers be 500 volts and C be 10 per cent. of the full load current; also let the internal drop of the armature be 4 per cent.

$$\text{Then } 10\ C\ R = 20 \text{ and } C = \frac{2}{R}.$$

We will take it that $r = R$, that is, the resistance of the balancer is one-half the resistance of the armature, which would be about what is usual. It follows that the drop is:—

$$\tfrac{1}{2} \cdot C\left\{r + \tfrac{2}{3}R\right\} = \frac{1}{R}\left\{R + \tfrac{2}{3}R\right\} = 1{\cdot}66 \text{ volts.}$$

That is to say, with a total out-of-balance current equal to 10 per cent. of the full load current, the difference in voltage on either side of the network will be 1·66 volts, equal to ·66 per cent.

Working out the same calculation for a three-phase balancer having the same current density in the balancer, one gets as drop in this case

$$\frac{C}{3}\left\{\tfrac{3}{2}R + \tfrac{2}{3}R\right\} = \frac{2}{3R}\left\{\frac{13}{6}R\right\} = \frac{26}{18}$$

$$= 1{\cdot}44 \text{ volts,}$$

$$= {\cdot}57 \text{ per cent.}$$

For a six-phase balancer the drop is

$$\frac{1}{3R}\left\{3R + \tfrac{2}{3}R\right\} = \tfrac{1}{3}\left\{3{\cdot}66\right\}$$

$$= 1{\cdot}22 \text{ volts,}$$

$$= {\cdot}49 \text{ per cent.}$$

From this it is obvious that it is of advantage to bring the out-of-balance current into the armature in as many places as possible. It is also of great importance to keep the ohmic resistance of the balancer windings down as much as possible. If, in the above example, r had been less than R, as is quite possible, the advantage of using a polyphase balancer would have been still more marked.

(*b*) *Balanced Circuit.*—In the case where there is not any out-of-balance current, C = 0, and the expression for the difference in voltage reduces to zero; thus the mid-point O of the balancer is the true mid-point between the positive and negative. It is helpful to look at this from another point of view. Referring to fig. 2, which shows a single-phase equaliser, and assuming that the load is balanced, we get from Kirchoff's Law, at any instant—

E.M.F. from B_1 to O = E.M.F. from B_1 to a + E.M.F. from a to O, and E.M.F. from B_2 to O = E.M.F. from B_2 to b + E.M.F. from b to O.

These E.M.F.'s are made up partly by induced E.M.F.'s and partly by C R drops. As we are assuming balanced loads, the C R drops can be neglected, and we therefore only have to consider the induced E.M.F.'s. As the slip rings are connected to diametrically opposite points in the winding, we have—

E.M.F. from B_1 to a = E.M.F. from B_2 to b.

We have also—

E.M.F. from a to O = E.M.F. from b to O.

Thus it follows that at every instant—

E.M.F. from B_1 to O = E.M.F. from B_2 to O.

O is therefore the true connection for the mid-wire of the system.

4. *Design.*—(*a*) *Periodicity and Voltage.*—If P be the number of pairs of poles in the continuous-current generator, and n the speed (r.p.m.), then the periodicity for which the balancer must be constructed is $\frac{P\,n}{60}$ periods per second. Generally speaking, this comes out at about 20 periods per second. If the direct-current voltage between outers is V volts, then the voltage between phases of the balancer is ·612 V volts when the balancer is constructed three-phase. With a single-phase construction, the voltage is ·707 V volts, and for a six-phase balancer, the voltage between adjacent collector rings is ·354 V.

(*b*) *Iron Circuit of Balancer.*—Referring to fig. 2, it will be seen that as regards the alternating voltage existing between the slip rings the balancer acts as a choke coil. With proper design very little alternating current will flow in the windings of the balancer. It is important, of course, to keep the alternating current that flows down to a minimum, as not only is this a source of loss in the balancer, but it is also a waste of energy in the generator itself. There will be practically no magnetic leakage due to the A.C. voltage in the balancer. Directly, however, out-of-balance continuous current begins to flow back through the balancer the conditions are altered. In addition to the alternating-current magnetisation there will be a superimposed continuous current magnetisation, the amount of which depends on the type and design of the balancer.

The figs. 4 and 5 represent the cores of single and three-phase balancers respectively. The letters N and S represent the polarity of the magnetism induced in the iron by the continuous current. It will be seen that in the case of the single-phase balancer the continuous-current magnetisations in each leg oppose one another, and it is possible by sub-dividing the coils and suitably spacing them, or by using concentric coils, to quite neutralise the magnetising effect of the continuous current without affecting the choking effect on the alternating voltage. In the case of the three-phase balancer this neutralisation is not possible. In the first place, a similar spacing of the coils as in the single-phaser cannot be carried out, as each phase must be kept separate. Then, again, if two legs are looked upon as neutralising each other, there yet remains the third leg with a closed magnetic circuit and quite un-neutralised.

To get over this difficulty, Steinmetz has made the suggestion that the conductor from the neutral point to the mid-wire should be wound round each leg a sufficient number of times (equal to one-third the number of turns that would otherwise be on each leg), and in the opposite direction to the other winding, so that the continuous-current magnetisation would be completely neutralised. There will be three electromotive forces induced in this special winding, but as they will differ by 120° in phase from each other, the resultant E.M.F. induced in the mid-wire will be zero. This method, while it is a radical cure, very considerably increases the weight of material in the balancer and renders the same more difficult to build.

With a three-phase construction, therefore, as neutralisation cannot be readily obtained, it is best to put up with the continuous-current magnetisation, and the resultant considerable magnetic leakage from the balancer which takes place directly out-of-balance current flows, and allow for both in the design.

(*c*) *Iron Loss.*—When the continuous-current magnetisation is entirely neutralised, the calculation of the iron loss is done in exactly the same way as with a static transformer, and it is not necessary to dwell on this here. When, however, the continuous-current magnetisation is not neutralised, the state of affairs is different, and the calculation of the losses is a matter of some difficulty. To fix ideas, we will consider a three-phase balancer. Considering the magnetism in each leg, we have an alternating-current magnetism superimposed upon a continuous magnetism. In the event of there being no continuous current flowing, the magnetic flux will follow a law like the curve in fig. 6.

With continuous current in addition, the flux will vary as in fig. 7.

It will be seen that the *direction* of the magnetic flux may never change. The maximum induction reached, however, is bound to be considerably higher than without direct

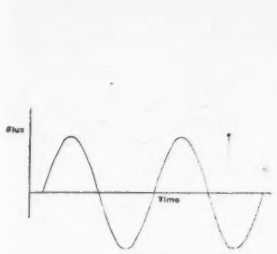

Fig. 6.

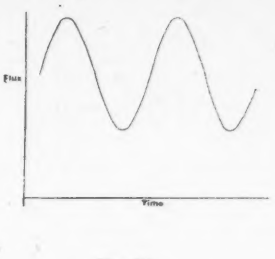

Fig. 7.

current, and it follows that the iron loss and alternating magnetising current will be affected by the amount of out-of-balance direct current flowing.

The usual tables of iron loss in the cores of transformers which are available, give the iron loss corresponding to certain maximum inductions in the iron, only, however, for the case that the magnetisation is reversed equally during each cycle. Such tables cannot be used for calculating the iron loss to be expected in the balancer.

The matter is further complicated by the fact that the balancer, in common with all other similar apparatus, has to be enclosed in an iron tank. Directly, however, the out-of-balance current flows, there is considerable magnetic leakage. This leakage is of a pulsating character, and naturally is the cause of losses in any metal in the neighbourhood of the balancer. In the following curves no attempt was made to separate the extra losses as between the core and the iron tank.

In order to obtain some experimental data, some experiments were made on a three-phase balancer designed for dealing with an out-of-balance current of 200 amperes on a 480-volt dynamo, the periodicity of the balancer being 25 periods per second. In this balancer no attempt had been made to neutralise the continuous-current magnetisation,

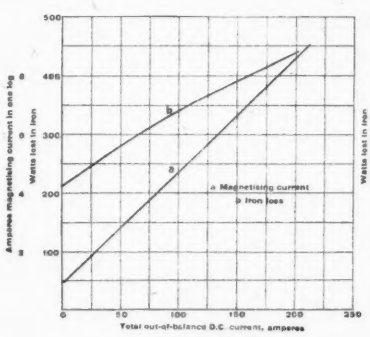
Amperes magnetising current in one leg
Watts lost in iron
a Magnetising current
b Iron loss
Total out-of-balance D.C. current, amperes

Fig. 8.

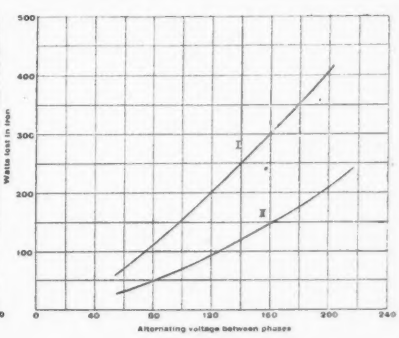

Fig. 9.

Fig. 8.—Variation of Iron Loss and Magnetising Current, with Constant A.C. Voltage of 200 between Phases, and Varying Out-of-Balance Direct Current.

Fig. 9.—Variation of Iron Loss, with Constant Direct-Current Magnetisation and Varying Alternating Voltage Applied.

onstant continuous current of 66·6 amps. per leg, corresponding to total out-of-balance current of 200 amperes.

I = Iron loss with direct current: II = Iron loss without any out-of-balance direct current flowing.

although the apparatus was designed so that the said magnetisation was reduced to a minimum (see paragraph 4*d*). The following particulars regarding the balancer in question will help to a right interpretation of the results :—

Length of mean turn of winding	32·3 in.
Continuous-current ampere-turns per centimetre length of winding at full load	136
Cross section of core ... ... (Corresponding to 302 sq. cm. of iron.)	332 sq. cm.
Mean length of closed magnetic circuit, *i.e.*, circuit embracing two of the legs	145 cm.

The balancer was contained in an ordinary ribbed cast-iron tank.

The curves given in figs. 8 and 9 give the results of the measurements. Fig. 8 shows the variation of the iron loss and magnetising current, with a constant alternating-current voltage of 200 between the terminals of the balancer, and with varying total amounts of out-of-balance direct current. It should be mentioned that 200 volts between phases, without any direct current, corresponds to a maximum induction of B = 4,530 lines per square centimetre in the core. The out-of-balance current per leg is one-third of that given in the curve. It will be seen that due to the out-of-balance current the iron loss is more than doubled. The magnetising current given is that measured in one phase. It was not equal in all three phases, as the construction of the core of the balancer was asymmetrical. The curve shows, however, the enormous variation of the magnetising current due to the direct current.

Fig. 9 shows the variation of iron loss in the balancer with varying alternating voltage, and constant direct current of 200 amperes out-of-balance current. Curve II of fig. 9 shows the iron loss in the balancer, without any direct out-of-balance current flowing whatever.

From these curves it will be seen that it is very necessary, when considering the design and temperature rise of such a machine, to take into account the increased iron loss due to the out-of-balance current, and so to design the core that the continuous-current magnetic flux is a minimum.

(*To be concluded.*)

LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names may be made. Answers are furnished by a barrister-at-law.*]

No. 90.—Refusal to Supply Electricity.—Remedy of Consumer.

"Demand" writes:—"I should be pleased if you would inform me if I have any means of compelling the electric supply department of the Corporation to connect me to their mains. I have made several applications on their prescribed form, but can only get curt refusals, because they state their station is overloaded. Some can get put on for lighting, but as I want energy for power, I am refused. Can I give them notice that unless I am connected in —— days I shall take proceedings?

"When the department was worked at a loss, I had to help make up the loss in my rates, and now when I want to use the department I cannot get connected.

"The cause of the works being overloaded is that two large works have come on and swamped them, to the detriment of small consumers. The mains run right by my premises."

*** The Electric Lighting Act, 1882, Sec. 19, provides in terms that every person within a supply area is entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply. It is further expressly provided by the Electric Lighting (Clauses) Act, 1899, Schedule, Sec. 30, that whenever the undertakers make default in supplying energy to any owner or occupier of premises to whom they may be, and are, required to supply energy under the special order, they shall be liable in respect of each default to a penalty not exceeding 40s. for each day on which the default occurs.

Practically speaking, the undertakers can only escape liability under this section if the default is caused by inevitable accident or *force majeure*, or if it is of so slight or unimportant a character as not materially to affect the value of the supply. There is no case in the books which shows that a supply authority may rely upon the fact that their station is not large enough, in order to justify a refusal to supply. "Demand" should serve a notice specifying the premises, the maximum power required, and the day upon which the supply is required. He must be prepared to enter into an agreement to take a minimum supply for a certain period. On the failure of the local authority to comply with the notice, "Demand" may proceed against them for penalties in the police court.

Cardiff Exhibition.—A very successful Trades Exhibition has just been held at Cardiff. An interesting feature was the stand taken by the local electricity department, which was fitted up with various kinds of electric light fittings, floor and table standards, ship fittings, a number of cooking and heating appliances, &c., and an extensive collection of lamps of various types. One of the "Ediswan Carbone" white flame arcs was giving daylight effects. Some of these lamps were exhibited by request at the rooms of the Royal Institution a few weeks ago.

NEW PATENTS APPLIED FOR. 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

10,091A. "Improvements in electric telegraph apparatus." W. Sutcliffe. (Date applied for under Rule 5 of the Patents Rules 1905, May 1st, 1907.) May 31st.

12,188. "Means for obtaining collecting and indexing electrical energy supplies from continuous-current dynamos, motors, and the like at various voltages, simultaneously or otherwise." G. Lister, W. Leath, J. Morgan and W. A. Harris. May 27th. (Complete.)

12,198. "Improvements in and connected with electric switches." B. Wiesengrund. May 27th.

12,217. "Improvements in apparatus for measuring the logarithmic decrement of high-frequency electric circuits." Marconi's Wireless Telegraph Co., Ltd., and F. C. Prentice. May 27th.

12,220. "Improvements in the production and employment of electric currents of high periodicity and in apparatus or appliances therefor." J. Y. Johnson. (Badische Anilin & Soda Fabrik, Germany.) May 27th.

12,223. "Improvements in and connected with electric arc lamps." J. O. Girdlestone and C. F. G. Thorkelin. May 27th. (Complete.)

12,238. "Improvements in and relating to systems for electrically-operating signals, points and the like." British Thomson-Houston Co., Ltd. (Allgemeine Electricitäts-Gesellschaft, Germany.) May 27th.

12,243. "Improvements in dynamo electric machines." H. Leitner. May 27th.

12,244 "Improvements in systems of electric train lighting." H. Leitner. May 27th.

12,245. "Improvements in systems of electric train lighting." H. Leitner. May 27th.

12,250. "Improvements in connection with electric switches." B. O. Butler. May 27th.

12,253. "Improved alternating-current electromagnet." H. Beck and Deutsche Beck-Bogenlamp Gen.-G.m.b.H. May 27th. (Complete.)

12,260. "Combination lamp for electric or gas light, or both together." H. A. Rhode. (Date applied for under Patents Act, 1901, May 25th, 1906, being date of application in Germany.) May 27th. (Complete.)

12,315. "Electric wall lamp with watch-hanger and dry cell." M. Musger. May 28th.

12,321. "Improvements in electric locomotives." A. C. Kelly. May 28th.

12,322. "Improved automatic thermo-mercury switch for making and breaking electric circuits." A. J. Boult. (T. A. Rolfe, New South Wales.) May 28th.

12,324. "Apparatus for automatically starting or stopping electric motors." W. Hooker and W. E. Northy. May 28th.

12,342. "Improvements in and relating to printing telegraph receivers." J. Burry. May 28th. (Complete.)

12,353. "Receivers for wireless telegraphy." L. W. Austin. (Date applied for under Patents Act, 1901, May 29th, 1906, being date of application in U.S.) May 28th. (Complete.)

12,356. "Improved method of signalling by means of electric light and apparatus therefor." S. Stepanow. May 28th. (Complete.)

12,368. "Improvements in and relating to electric amperemeters, voltmeters and the like." A. Lehmann. May 28th.

12,374. "Improvements in electric generators." H. W. Lake. (W. Hallock, U.S.) May 28th. (Complete.)

12,386. "Improvements in or relating to the electrical propulsion of marine vessels." H. A. Mavor, Mavor & Coulson, Ltd., and J. H. Biles. May 28th.

12,389. "Improvements in or relating to wireless transmission. H. A. Yarnell. May 28th. (Complete.)

12,402. "Improvements in mechanism for operating magneto machines." S. Griffin. May 29th.

12,406. "Improvements in electric apparatus for communicating between one part of a vessel and another and for analogous purposes." T. A. Sedgwick. May 29th.

12,407. "Improvements connected with ships' telegraphic and analogous apparatus." A. J. Grant. (G. A. Haggarty, on the high seas.) May 29th.

12,420. "Improvements in or relating to dynamo-electric machinery." Lancashire Dynamo and Motor Co., Ltd., and W. Stansfield. May 29th.

12,430. "Improvements in holders or sockets for electric incandescent lamps." G. B. Stern. May 29th.

12,435. "Appliance for signalling by which a bell or the like on an engine or any other vehicle running on rails may be rung direct from the signal box, informing the driver of danger or otherwise on the line." J. G. Carr. May 29th. (Complete.)

12,436. "Cross-arms for carrying telegraph, telephone, or other wires or ropes." H. M. Sciple. May 29th. (Complete.)

12,443. "Improvements relating to the regulation or control of electric motors." J. S. Raworth and A. Raworth. May 29th. (Complete.)

12,458. "Improvements in electric trolley line construction." T. Varney. (Date applied for under Patents Act, 1901, June 4th, 1906, being date of application in United States.) May 29th. (Complete.)

12,462. "Improvements in sockets for electrical purposes." E. L. Pinching and W. H. Walton. May 29th.

12,484. "Improvements in and relating to electric transformers." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 29th.

12,489. "Armature winding machine." W. Cramp. May 30th.

12,529. "System of telegraphic and telephonic communication." L. Maiche. (Date applied for under Patents Act, 1901, May 30th, 1906, being date of application in France.) May 30th. (Complete.)

12,531. "Improvements in electric connectors or couplings." H. Turner. May 30th. (Complete.)

12,532. "Improved contact spring or the like for electrical apparatus." Deutsche Telephonwerke G.m.b.H. (Date applied for under Patents Act, 1901, May 31st, 1906, being date of application in Germany.) May 30th. (Complete.)

12,552. "Improvements relating to the measurement of electrical energy." F. Conrad and W. M. Bradshaw. (Date applied for under Patents Act, 1901, June 4th, 1906, being date of application in United States.) May 30th. (Complete.)

12,563. "Improved method of, and apparatus for, rendering electrolytic copper homogeneous." La Societe Jullien & Dessolle. (Date applied for under Patents Act, 1901, May 31st, 1906, being date of application in Belgium.) May 30th. (Complete.)

12,578. "Improvements in self-regulating electrical machines for alternating or direct current." A. Heyland. (Date applied for under Patents Act, 1901, May 30th, 1906, being date of application in Germany.) May 30th. (Complete.)

12,581. "Improvements in and relating to electric furnaces." J. B. Trillon and Societe Electro-Chimique du Giffre. (Date applied for under Patents Act, 1901, September 26th, 1906, being date of application in France.) May 30th. (Complete.)

12,585. "Improved apparatus for telegraphing type-printed messages." J. Haar. May 30th. (Complete.)

12,588. "Improvements in and relating to armatures." T. P. Stayz. May 30th.

12,593. "Improvements in and relating to electric transformers." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 30th.

12,624. "Improvements in or connected with arc lamps." H. Brown. May 31st.

12,632. "Improvements in and relating to automatic switches for preventing excessive current on circuits in which a variable current flows." A. Stewart. May 31st.

12,633. "Improvements in methods of producing electric oscillations." R. C. Galletti. (Date applied for under Patents Act, 1901, January 29th, 1907, being date of application in Italy.) May 31st. (Complete.)

12,634. "Improvements in methods of producing electric oscillations." R. C. Galletti. (Date applied for under Patents Act, 1901, March 9th, 1907, being date of application in Italy.) May 31st. (Complete.)

12,635. "Improvements in or relating to wireless telegraphy." R. C. Galletti. (Date applied for under Patents Act, 1901, December 29th, 1906, being date of application in Italy.) May 31st. (Complete.)

12,636. "Improvements in or relating to wireless telegraphy." R. C. Galletti. (Date applied for under Patents Act, 1901, January 24th, 1907, being date of application in Italy.) May 31st. (Complete.)

12,659. "Improvements relating to electrically-controlled systems." J. M. A. Rivals. (Date applied for under Patents Act, 1901, June 1st, 1906, being date of application in France.) May 31st. (Complete.)

12,664. "Improvements in multiple switches." O. T. Banks. May 31st.

12,702. "Improvements in and relating to the construction of containing cases for secondary cells." J. M. Rokes. June 1st.

12,709. "Improvements in inter-communication telephone systems." H. Hirst and W. L. Gullette. June 1st.

12,711. "Improvements relating to electric conductors for use in connection with installations of electric light." G. Davis. June 1st. (Complete.)

12,712. "Unidirectional current from spark coils." L. B. Miller. June 1st.

12,747. "Improvements in the electro-deposition of iron." S. O. Cowper-Coles. June 1st.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Process of Electric Welding. L. S. Lachman. 23,077A. November 17th. (Date applied for under Rule 5, Patents Rules 1905, October 8th, 1906.)

1906.

Manufacture of Electric Cables. C. J. Beaver and E. A. Claremont. 8,238. April 5th.

Conversion of Alternating to Continuous Current. W. L. Spence. 10,522. May 5th.

Alternating-Current Electric Motors. F. Punga. 10,585. May 5th. (Date applied for under International Convention, May 5th, 1905.)

Telephonic Exchange Systems. H. H. Lake. (Stromberg-Carlson Telephone Manufacturing Co.) 10,598. May 5th.

Telephone Exchange Systems. H. H. Lake. (Stromberg-Carlson Telephone Manufacturing Co.) 10,599. May 5th.

Telephone Exchange Systems. H. H. Lake. (Stromberg-Carlson Telephone Manufacturing Co.) 10,600. May 5th.

Telephone Apparatus. H. H. Lake. (Stromberg-Carlson Telephone Manufacturing Co.) 10,601. May 5th.

Electric Tail Lamps for Motor-Cars. G. J. Jackson. 11,028. May 11th.

Telephone Switchboard Cord Reel. J. E. Kingsbury. (Western Electric Co.) 13,050. June 5th.

Electric Switches and Operating Mechanism Therefor. British Thomson-Houston Co.) (General Electric Co.) 13,415. June 11th.

Prepayment Mechanism for Electric and other Meters. J. Allan. 14,342. June 22nd.

Apparatus for Controlling and Operating the Points of Electric Railways and Tramways. W. H. Turner. 17,288. July 5th.

Mirrors, and in Electrically Illuminating Objects to be seen therein. E. P. Hides and H. Burrell. 16,456. July 21st.

Electric Arc Lamps. F. Proctor. 16,668. July 24th.

Anodes for Electrolytic Purposes. F. Greenfield. 16,870. July 26th.

Electrical Current Interrupters. Felten & Guilleaume-Lahmeyerwerke Akt.-Ges. 17,343. August 18th. (Date applied for under International Convention, August 18th, 1905.)

Electric Glow-Lamp Holders, Specially Applicable to Metallic Conduits. L. M. Waterhouse. 18,445. August 17th.

Alternating-Current Electro-Magnets. Felten & Guilleaume-Lahmeyerwerke Akt.-Ges. 20,719. September 18th. (Date applied for under International Convention, September 30th, 1905.)

Controllers for Electric Elevators and the like. K. R. Odman. 21,146. September 24th. (Date applied for under International Convention, March 1st, 1906.)

Controlling Mechanism for Electric Lifts and other Purposes. J. C. Etchells. 22,465. October 11th.

Electrical Ignition of Internal Combustion Engines. J. Lloyd. 23,152. October 19th.

Electric Driving of Winding Engines in Conjunction with Turbo-Generators. A. Aichele. 25,200. November 8th.

Vapour-Electric Converters. J. H. Von Keller. 27,076. November 28th. (Date applied for under International Convention, December 5th, 1905.)

1907.

Magnetic Separators. S. O. Cowper-Coles. 1,085. January 15th.

Electrical Switches. C. M. Dorman, R. A. Smith and H. G. Baggs. 1,801. January 24th.

Trolley Wheels for Overhead Conductor Systems of Electric Tramways and like Purposes. J. S. Hilton and A. Dawson. 2,555. February 1st.

Electro-Magnetic Couplings for Railway Signals. Siemens Bros. & Co. and L. M. G. Ferreira. 2,748. February 4th.

Current Collectors for Electrically-Propelled Vehicles. Allgemeine Elektricitäts Gesellschaft. 4,263. February 20th. (Date applied for under International Convention, February 23rd, 1906.)

Magnetically Releasable Locking Device for Miners' Lamps and the like. O. M. Muller. 5,849. March 11th.

Sparking Plugs for Internal Combustion Engines. R. Bosch. 7,269. March 26th. (Date applied for under International Convention, April 2nd, 1906.)